DOCUMENT RESUME

ED 199 082 SE 034 422

AUTHOR	Harris, Pam
TITLE	Measurement in Tribal Aboriginal Communities.
INSTITUTION	Northern Territory Dept. of Education, Darwin (Australia).
REPORT NO	ISBN-0-7245-0457-5
PUB DATE	80
NOTE	127p.
AVAILABLE FROM	Northern Territory Dept. of Education, Professional Services Branch, Private Mail Bag 25, Winnellie, Northern Territory, Australia 5789 (no price quoted).
EDRS PRICE	MF01/PC06 Plus Postage.
DESCRIPTORS	*Cultural Differences; Curriculum Development; Educational Research; Elementary Secondary Education; *Learning Problems; Mathematics Curriculum; *Mathematics Education; Mathematics Instruction; *Measurement; Problem Solving; Surveys
IDENTIFIERS	*Aboriginal People; Australia; *Mathematics Education Research

ABSTRACT

This study focuses on a questionnaire survey undertaken in 1977 in which the concepts and use of measurement in tribal Aboriginal communities in Australia were investigated. The document opens with a review of a 1975 survey of numeracy skills in 10- and 14-year-olds in Australia which showed Aboriginal students often performed at a much lower level than the overall population. The report suggests that one significant cause of this lower performance is the lack of congruence between the aims of the school program and the home background of the Aboriginal child. Literature is reviewed which shows that these children do have mathematical skills not recognized or used in the schools because they do not arise from the Western-based cultural viewpoint. The greater part of the report is given over to a response summary to the eight standard question types in the 1977 questionnaire. The document concludes that any applied number program prepared for English-speaking white Australian children living in mainly urban situations is likely to be both inappropriate and inadequate for many Aboriginal children. (MP)

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ISBN: 0 7245 0457 5

FOREWORD

In comparatively recent times, the Northern Territory assumed complete responsibility for the delivery of educational services to the people within its boundaries. The N.T. Department of Education is not unique in Australia in facing problems of considerable magnitude in the exercise of its responsibilities. However, some of the problems it faces are unique.

One such problem is the provision of educational services to a population which includes a substantial proportion of Aboriginal students having varying degrees of contact with "European" culture. In many instances these students' ordering of reality may rest on assumptions different from those underlying the assumed reality of subjects comprising the curriculum in a "European" school. Much more needs to be known about Aboriginal students' structure of knowledge associated with their cultural background.

This monograph contributes much-needed understanding in the curriculum area of mathematics. It is the type of applied research likely to be widely accepted by classroom practitioners, having had its genesis in a teacher's desire to know more. The work reported results from disciplined inquiry following the initial motivation.

This monograph is not the first of a series, but one cherishes the hope that it may inspire reports of similar research endeavours in the future.

The Department of Education is pleased to support Ms Harris' contribution to a more informed basis for decision-making by both administrators and teachers and hence towards partial solution of the problem of providing the most effective education for all students in the Northern Territory.

(N. F. BOWMAN)
Assistant Director
Evaluation and Research

May, 1980

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PREFACE

The work published in this monograph really began in 1976 when a far sighted lecturer in Remedial Mathematics gave the first year Bachelor of Special Education students at Monash University, of whom I was one, an open-ended assignment.

He said that we could choose something that we had always wanted to do, but had never been able to do because of lack of facilities or shortage of time. I had no hesitation in stating what I wanted to do. I had, for the previous six years, been working in an Aboriginal school situated in a strongly traditional Aboriginal community, and questions uppermost in my mind were - "What does the young Aboriginal child know of mathematics when he or she first starts school? How much are we building on what our pupils already know, and how much of what we teach will be reinforced in their home and family life? Will some of it, perhaps most of it, be in direct conflict with their traditional values?"

My questions were much too complex of course (I am now working on them full time), but I made a start by writing to people all over Australia, asking for assistance in collecting any unpublished information available on the subject. I had already found that there was very little published information to which I could refer.

From this survey, I was able to distribute a bibliography of the unpublished information received, and this, together with full details of the survey and copies of the material gathered, has now been lodged with the Institute of Aboriginal Studies in Canberra for general reference.

This 1976 survey highlighted several points:

(1) there appeared to be a marked scarcity of background information available to people teaching, or preparing to teach, mathematics to tribal Aboriginal children

(2) there appeared to be much information locked away in the minds and experience of Aborigines and people who had long worked with Aborigines, which, if it could be brought to the surface and put together, would be a valuable resource for teachers, and

(3) teachers and others involved with Aboriginal education felt a need for research into the teaching of mathematics in their situation, and would be willing to help within the limitations of their own resources.

As a result of these findings, in 1977 I undertook at Monash University the research project which is reported here. The Northern Territory Department of Education later allowed the use of its facilities to prepare the study for publication, and also advised me on revision and updating of the text. The main change from the 1977 version is the inclusion in Chapter 3 of a discussion regarding the language to be used as the medium of instruction for mathematics in schools which have a program of bilingual education.

I am indebted to many people for their practical help and encouragement in this project, but especially to my supervisor,

Mr M. A. (Ken) Clements

Senior Lecturer in Education at Monash University

Without his guidance and unflagging enthusiasm, I would never have begun this project, let alone completed it.

Dr David Lancy, Principal Research Officer of the Department of Education in Papua New Guinea encouraged my interest in this topic at the beginning and continued to share with me details of the Indigenous Mathematics Project which he was directing in Papua New Guinea. I appreciated his interest.

Dr Jim Cameron, who was then Acting Principal Education Adviser, Curriculum Development, in the Northern Territory Department of Education, helped me and encouraged me through the difficult process of revising and updating.

Several colleagues read through the final draft and offered more suggestions and criticisms which led to last minute improvements. They also found all the errors and omissions which I was no longer able to see, having read it too many times before. I am grateful for their assistance.

I am also grateful to my sister *Rosemary Harris* for giving up part of her holidays to type the original copy, and to *Margaret Webster* for her careful work on the final typescript.

Finally, I wish to acknowledge my indebtedness to the many people who, in questionnaire replies, letters, and conversations, contributed information and ideas which have been incorporated into this report. Part II of the book is their work at least as much as it is mine.

(PAM HARRIS)
DARWIN

March, 1980

ABSTRACT

A national survey of literacy and numeracy skills in 10 and 14 year olds in Australia showed that Aboriginal students often performed at a much lower level than the overall Australian population. The writer, who is concerned with mathematics education in Aboriginal schools, suggests that one significant cause of this lower performance is the lack of congruence between the aims of the school program, and the home background of the Aboriginal child. Literature is reviewed which shows that Aboriginal children do have mathematical skills which are not recognised or used in the school situation, because they do not arise from the Western cultural viewpoint on which school curricula and textbooks are based.

The remainder of the report describes a questionnaire survey undertaken in 1977 in which the concepts and use of measurement in tribal Aboriginal communities in Australia were investigated. The topics covered were Length, Height, Distance, Time, Speed, Weight, Area, Volume, and Money. Most of the items on the questionnaire presented a statement in English and asked the respondent to rate the difficulty of translating that statement into the vernacular spoken in the community. The assumption was that if the English term or the English statement were very difficult to express, or were expressed very differently in the Aboriginal child's own language, then the child could be expected to have difficulty in learning it in English, a second language which he has not yet mastered.

The greater part of the report is given over to a summary of responses to the eight standard question types in the questionnaire. These questions dealt with (1) the availability and use of abstract terms such as 'length', 'distance', (2) the availability of local units of measure, (3) the use of local units of measure, (4) the understanding and use of standard units of measure, (5) the use of equivalence statements of the type A = B, (6) the use of equivalence statements of the type A + B = C, (7) ways of expressing the comparative, and (8) ways of expressing the superlative.

The responses showed that it is not customary in Aboriginal society to use local units of measure, and standard units of measure are little understood, even where they are required in European introduced employment. It is also contrary to custom to add measures together as the type 6 questions required. It was not considered difficult to make equivalence statements of the type A = B, or to express the comparative and superlative degrees of comparison in Aboriginal languages.

Of the nine topics covered, Volume, Area and Time were given the highest difficulty ratings: Volume and Area because they seemed irrelevant in traditional Aboriginal life, and Time because Aboriginal people have such a different view of time from that of Western people. Many of the respondents' comments are quoted verbatim to illustrate Aboriginal views of measurement.

The writer comes to the conclusion that any applied number program prepared for English speaking white Australian children living in mainly urban situations is likely to be both inappropriate and inadequate for vernacular speaking Aboriginal children living in tribal Aboriginal communities, and she recommends that further research should be undertaken with the aim of developing mathematics curricula appropriate to the environment and needs of tribal Aboriginal children in Australia.

INTRODUCTION

"The chapters that follow . . . at least . . . serve to guard us against the illusion that the child of [Melbourne, or Sydney, or Townsville] is the 'standard child' from which all others deviate. There is no 'standard child' and 'natural childhood' is hard to imagine outside a cultural context."

(Jerome Bruner, in Studies in Cognitive Growth)

INTRODUCTION

In October 1975, the Australian Council for Educational Research (ACER) measured the achievement in reading, writing, and number of 10 and 14 year old students in normal schooling throughout Australia (Bourke & Keeves, 1977). The third volume of the resulting report contains a chapter on the performance of Aboriginal students compared with the performance of the overall Australian population (Bourke & Parkin, 1977). For the purposes of the report, two groups of Aboriginal students were distinguished. Group 1 consisted of Aboriginal students attending Aboriginal schools in the Northern Territory. These schools are small and in remote localities on missions, stations and settlements and, because of their location, are mainly attended by Aboriginal students. Group 2 consisted of Aboriginal students attending other schools, both in the Northern Territory and the rest of Australia. The majority of students at these schools are of European racial origin, with Aboriginal students forming a small proportion of the school enrolment. In this present work we shall be concerned primarily with Group 1 Aboriginal students.

Results on selected items were presented in the report and they showed that Group 1 Aboriginal students had performed at a much lower level than the overall Australian sample. One example is the comparison of performances on reading the time. Both the 10 and 14 year old students tested were asked to write down the time shown on a watch-face. The watch used for the younger students had Arabic numerals on the face whereas that used for the older students had only strokes. The times shown were 11.35 and 4.40 for the 10 and 14 year-old students respectively and the results obtained are shown in Table 8.19 of the report, which is reproduced below.

TABLE 8.19

Performance on Reading the Time by Students

Aged 10 and 14 Years

	Aboriginal Students		Australia
% Correct	Group 1	Group 2	Overall
10 year-old	2	25	71
14 year-old	3	73	89

The writers, commenting on the fact that very few Aboriginal students in Group 1 could perform this task, said that the task itself was "almost certainly outside the experience of many" (p. 149). Admittedly, this is an extreme example, chosen partly for its brevity, and also because it relates directly to the Time topic of the questionnaire discussed in Part II of this report. However, similarly poor performances are recorded for tasks involving money; and the performances on recall of number facts and use of the four operations, although better than on money calculations and reading time, are still well below the performances of Group 2 Aborigines and the overall population.

The discussion of student characteristics in the report indicates some background variables which may have contributed to the poorer performance of Aboriginal students. Characteristics in which Aboriginal students were perceived by their teachers as being different from other students throughout Australia were presented and discussed. These included: less regular attendance at school, lack of understanding of English, untreated hearing problems, and shyness and timidity in class. Although these factors no doubt contributed to the poorer performance of Aboriginal students, they go only part of the way towards explaining it. As Watts has pointed out, "it is not the characteristics of the learner per se which lead to school failure, but rather the lack of congruence between the child and the school" (cited in Grant, 1972, p. 10). This lack of congruence is evident in all areas of Aboriginal education (in its formal school sense), but perhaps nowhere is it so marked as in the area of mathematics.

In the past, those concerned with Aboriginal education have often adopted the attitude that Aborigines are disadvantaged when it comes to learning modern mathematics, and it is therefore necessary to reduce and adapt the curriculum and look for ways of "making mathematics more relevant in the home and community" (Infants Curriculum 1974, pp.121-22). There is an implicit assumption here that modern mathematics is something that Aborigines in tribal communities need to learn, and that the specific areas of mathematics which they need to learn are covered in a curriculum which is very little different from that presented to English-speaking white Australian children living in urban communities. The fact that it is necessary for the teacher to look for ways to *make* modern mathematics more relevant suggests that the needs of the Aboriginal child are *not* met by such a curriculum.

It is not being suggested here that Aboriginal pupils should not be taught mathematics. Aborigines, like any other group of people, constantly use mathematical ideas in their daily life, consciously or unconsciously, and the children have a right to inherit the knowledge and skills of their parents, as well as to learn new skills to help them cope with a changing society. The question is: what *kind* of mathematics should be taught to Aboriginal pupils; and how does this compare with the usual mathematics curriculum which is based on western European thought expressed in the English language?

This study attempts to give a partial answer by:

1) presenting a review of the literature related to Aborigines and mathematics,

2) presenting a summary of the results of a questionnaire survey which dealt with one area of mathematics (measurement) in relation to Aboriginal life and languages, and

3) discussing some of the implications of the survey for the teaching of mathematics in Aboriginal schools.

It should be noted that, as a general rule, the word *Aboriginal* in this report refers to Aboriginal people living in a tribal situation where the child's first language is an Australian Aboriginal language, and English is learned as a second language at school. Most of the Aboriginal communities referred to in the report are in remote locations in the Northern Territory, North Queensland, and Western Australia. Some of the languages mentioned are also spoken in the far north of South Australia.

PART ONE

ABORIGINES AND MATHEMATICS: A REVIEW OF THE LITERATURE

aboriginal a. *indigenous, existing in a land at dawn of history or at arrival of colonists.*

mathematics n. *science of space and number in the abstract.*

(Australian Pocket Oxford Dictionary)

CHAPTER 1

MATHEMATICS IN ABORIGINAL SOCIETY

> *"Aborigines knew north, south, east and west before the white man's compass."*
>
> (Wintinna Mick, quoted in Lewis, 1976.)

CHAPTER 1

MATHEMATICS IN ABORIGINAL SOCIETY

When people talk about the mathematical ability of the Australian Aborigines they almost always focus attention on the ability to count and calculate using the four operations and, as Aborigines generally have not performed well on these types of tasks in comparison with white Australians, the conclusion has frequently been drawn that Aborigines generally lack mathematical ability.

This results from a very narrow definition of mathematics, especially as it relates to school learning. Rarely has attention been drawn to other areas of mathematics in which the ability of the Australian Aborigines is not only equal to that of white Australians, but in some respects far superior.

Mathematical instinct

An outback schoolteacher, Mary Montgomerie Bennett, was greatly impressed by what she referred to as the "mathematical instinct" of her Aboriginal pupils. "The most remarkable thing", she wrote, "is the ability of the children to grasp a new conception of numbers as our arithmetic is to them" (Bennett, 1957, p.46). Mrs Bennett, who taught first at Ernabella in the far north of South Australia, and later at Mt. Margaret in Western Australia, took Aboriginal children around the country to demonstrate their mathematical skills, using what she called a "bullboard", a large blackboard with numbers which were struck by sticks which had coloured ball ends, the different colours symbolising different mathematical processes (Douglas, 1976).

It was not only her pupils' ability to grasp new ideas of number that impressed her. She saw mathematics in their traditional life, too. To her, a boomerang in the hands of an Aborigine was "manual mathematics" (p.47), and she quotes Oswald Spangler who wrote:

> The Australian natives . . . possess a mathematical instinct (or, what amounts to the same thing, a power of thinking in numbers which is not communicable by signs or words) that as regards the interpretation of pure space is far superior to that of the Greeks. Their discovery of the boomerang can only be attributed to their having a sure feeling for numbers of a class that we should refer to the higher geometry (Cited in Bennett, 1957, p.47).

Spatial ability

Another remarkable skill of Aborigines is their ability to orientate themselves in relation to their environment, a skill which is poorly developed among white Australians. An Aborigine is never lost, and after a circuitous kangaroo chase, always heads directly back to the waiting vehicle. Lewis (1976), in a fascinating and well documented article on route finding and spatial orientation among Aborigines of the Western Desert region, gives the following example:

> The place was ... featureless and flat, with moderately open mulga and spear grass, devoid of sandhills, creek beds, escarpments, tall trees or other references. Visibility through the evenly-spaced mulga was a hundred metres at most.
>
> A kangaroo, wounded by a .22 bullet, was hunted on foot for half an hour. After it had finally been killed, Jeffrey and Yapa Yapa headed without hesitation directly back towards the Landrover, that had been invisible since the first minutes of the chase.
>
> *Question:* "How do you know we are heading straight towards the Landrover?"
>
> *Answer:* Jeffrey taps his forehead. "*Malu* (Kangaroo) swing round this way, then this", indicating with sweeps of his arm. "We take short cut".
>
> *Question:* "Are you using the sun?"
>
> *Answer:* "No".
>
> The Landrover duly appeared ahead through the mulga in about a quarter of an hour. Jeffrey then repeated his explanation, illustrating by gestures and by drawing in the sand the *malu's* track and our own 'short cut' home. (Lewis, 1976, p.262)

Lewis hypothesised an explanation of this ability in terms of a continually updated image or "mental map".

> It would appear then, that the essential psychophysical mechanism was some kind of *dynamic image* or *mental 'map'* which was *continually updated* in terms of time, distance and bearing, and more radically *realigned at each change of direction,* so that the hunters remained *at all times* aware of the precise direction of their *base and/or objective.* (Lewis, 1976, p.262).

This hypothesis was supported by the Aborigines' own explanations; for example, Jeffrey Tjangala's explanation of how he knew his way in the featureless stony desert country in which they were travelling:

> Jeffrey drew a cross in the sand to represent north, south, east and west (I confirmed by the stars that his directions were accurate).

> He said: "North, south, east and west are *like this in my head*. I know them because we were travelling west and circled back south until we were heading south-east when we made camp, so I know where the directions are". (Lewis, 1976, p.264)

As another Aborigine, Wintinna Mick, said: "Aborigines knew north, south, east and west before the white man's compass" (p.265).

Counting

Unfortunately for the Aborigines, the mainstream of Australian education is more concerned with counting and computations than it is with route finding in the desert or throwing boomerangs, and it has long been a part of Australian folklore that Aborigines cannot count beyond four or five.

As early as 1904, Howitt, in his *Native Tribes of South-East Australia,* sought to discount this view. He described how an Aboriginal messenger would enumerate the days or stages of a journey by successively naming points on his body, starting from the little finger and going up his arm until on the fifteenth count he reached the crown of his head. From there the count went down the other side of the body, naming corresponding places. Howitt concluded:

> This method of counting seems to do away with the often-repeated statement that the Australian Aborigines are unable to count beyond four or at the most five. By the above manner of counting they are able to reckon up to thirty, with names for each place (p.698).

Lack of numerals - a "gap" that can easily be filled

Although such examples of body counting can be found, it is nevertheless true that almost all Australian languages contain only two or three cardinal numerals. Wurm (1972), in his book *Languages of Australia and Tasmania,* says that "to a limited extent, higher numerals can be formed by combinations of the two or three numerals available, and in a few isolated instances, through the utilisation of terms indicating 'hand', 'foot', and 'person'". Exceptions are the two languages of eastern Arnhem Land which have developed "regular quinary systems of numerals which seem to extend indefinitely upwards" (pp.63-64).

Hale (n.d.) has some pertinent things to say about the lack of numerals in Aboriginal languages. He argues that although numerals are for the most part lacking, "counting itself is not lacking, in the sense that the principle of addition which underlies the activity of exact enumeration is everywhere present". In this sense, he suggests counting is universal, "and whether or not a conventionalised inventory of numerals exists in a given language depends upon the extent to which exact enumeration is of a practical use or necessity to the people who speak the language". He regards the lack of conventionalised numerals as being simply a "gap in the inventory of cultural items", and considers that, since the principle which underlies counting is present, "filling the gap is a rather trivial matter". In his opinion this view is entirely compatible with his own observation that the English counting system is almost instantaneously mastered by Warlpiris who enter into situations where the use of money is important (p.3). The Warlpiri are a large tribe in Central Australia with whom Professor Hale has had a long and close association.

One point of view excludes other points of view

It is a fact of life that the moment a people adopt one form of classification or espouse a particular point of view, they inevitably reject alternative classifications or points of view. Where Western mathematics, in keeping with the Western European world view, emphasises many calculations with large numbers, the Aborigines have always been intimately concerned with individuals and small numbers, and this is reflected in the languages. Judith Stokes (1976) refers to the "specialisation of small numbers" in Anindilyakwa, a language of eastern Arnhem Land. "In English", she writes, "we think of either one thing (singular) or a lot of things (plural), i.e. there are two categories. In Anindilyakwa the classification is more complex and there are four possible categories:

Singular - one

Dual - two

Trial - three

Plural - four or more

Subject, verb and object all repeat the details of number". (Stokes, 1976, p.3)

The white Australian often fails to appreciate the Aborigines' concern for detail regarding small numbers, and finds it difficult or impossible to comprehend their lack of concern for larger numbers and calculations which are such an important part of the Western lifestyle. As Vaszolyi, in his book introducing the study of Australian Aboriginal linguistics, says:

> We count, measure and weigh everything. Our principle idols, such as money and machines, all rest on a pedestal made of figures and calculations. For an Aboriginal hunter, however, figures and counting are irrelevant. (Vaszolyi, 1976, p.36).

He notes that Australian Aborigines do not stand alone with their reluctance to worship figures as we do, and cites other hunting-gathering tribes in America, Africa, and Asia who are, or were, "similarly unconcerned with arithmetic" (p.36).

Influence of social context

Vaszolyi devotes several pages to the topic of numerals. He points out that while the restricted number of numerals no doubt creates difficulties in learning arithmetic, this linguistic limitation does not indicate that Aboriginal people are incapable of learning or handling figures. He refers to Robinson and Yu's (1975) observations of the ease with which Aboriginal players handle the computations and money calculations required by games like *Kuns*, an Aboriginal card game. Their skill in these games is in contrast to the apparent inability of Aborigines to handle computations and money calculations in such situations as the school, the store and at work. (It should be noted that these are all activities which were introduced by Europeans.) The conclusion is drawn that the social context of an activity has an influence on the degree of mathematical skill shown in each situation.

Mathematics in card playing

The anthropologist, Berndt (1946), also writes of the Aboriginal people's skill in card-playing. He describes two games commonly played by Aborigines in the Northern Territory, and notes that "both games . . . involve much quickness of perception and mathematical calculation - thus serving further to refute the common fallacy that the Australian Aborigines cannot count to any high figure" (p.250).

On the other hand, Holm and Japanangka (1976), in their article on the mathematics of card playing in an Aboriginal community, are more concerned that the type of calculations used in the card games may interfere with school learning of mathematics in some ways. For example, they say that teachers should be aware that in the card game described there is no practical difference between 10, 20 and 30, all simply being referred to as "a ten". Also, for the purposes of the card game there is no difference between 2 and 12; and 7 is regarded as being of greater value than 16 (p.21). The card games have their rules, and the mathematics taught at school has its rules, but the rules are sometimes different.

CHAPTER 2

TEACHING MATHEMATICS IN ABORIGINAL SCHOOLS

> *"The teacher's primary duty is to his pupils. Understanding their minds is an essential qualification, without which he can neither discharge his duty, nor obtain the professional satisfaction essential to his well-being."*
>
> (Prince, 1969)

CHAPTER 2

TEACHING MATHEMATICS IN ABORIGINAL SCHOOLS

Teachers' attitudes towards mathematics instruction in Aboriginal Schools

A Western Australian teacher (Hindle, n.d.) wrote about his concern regarding the number conceptualisation of his Aboriginal pupils. He stated that in his opinion the problem goes much deeper than an inability to count higher than three or four in the tribal tongue, and said that in his experience almost all Aboriginals are plagued by an inability to solve even the most elementary problems involving number. He included in this the ability to measure accurately, give estimates of distances, time, weights or quantities and, in many cases, to see any real need to do so. Although Hindle's conclusions about his pupils' abilities are open to question, he was correct on at least one point; namely, that Aborigines in many cases see no real need to use the measurements that were mentioned. This is shown in the survey described in Part II of this report.

Many teachers start off with negative attitudes towards teaching mathematics to Aboriginal pupils. For example, Douglas (personal communication) states that some school teachers in Western Australia had come to the place where they confessed that they were not trying to teach mathematics to Aboriginal children any more on the ground that they had learned at teachers' college that Aborigines do not have any number concepts beyond one, two, three, and a lot. They felt, therefore, that Aboriginal children would never be able to do mathematics because they just did not have any mathematical concepts.

Two things should be noted here. One, that it is likely that the Aboriginal pupils are immediately disadvantaged by their teachers' low expectations, and two, that there is often a confusion in teachers' minds regarding the relationship between *mathematics* and *number*. There is a tendency to think that mathematics *is* number, and that the two are synonomous, instead of looking on the study of number as just one aspect of mathematics, important in a world of commerce and technology, but not of primary importance to tribal Aborigines. There is a noticeable lack of discussion of the teaching of mathematics in magazines especially written for teachers in Aboriginal schools, such as *Wikaru* from Western Australia, the former *Special Schools Bulletin* from the Northern Territory, and the *Aboriginal Child at School,* which is the national journal for teachers of Aborigines. Where mathematics is mentioned it is usually only in passing, with no detailed discussion.

An example is the article by June Whittaker in the February 1970 issue of the *Special Schools Bulletin*. In that article Mrs Whittaker, a lecturer in Infant Method at the college which trained Commonwealth teachers for Aboriginal schools in the Northern Territory, reported on her 1969 study tour of the Territory. She summarised what she thought were the four most common problems in teaching in Aboriginal schools at the ungraded infants level. In the area of Number she believed the main problem to be "failure to see pupils reach the high standards in number skills that have been guaranteed by committed Cuisenaire exponents" (p.3). She then proceeded to discuss at some length the problems she had mentioned in the areas of Oral Language and Written Expression, and to make recommendations for the better training of teachers in these areas. Number was not mentioned again.

The teacher and related research

For teachers who are interested in research related to the mathematical ability of Aborigines, probably the best known published studies are those by deLacey (1970) on classificatory ability, and deLemos (1969) and Dasen (1973) on the development of conservation. Each of these is included in the volume by Kearney, deLacey and Davidson (Eds.) *The Psychology of Aboriginal Australians* (1973). Although this type of research may assist the understanding of cognitive development of Aborigines in comparison to other groups, it is doubtful whether the findings reported have made any impact on classroom teaching in Aboriginal schools. One of the problems is that the findings of research are not readily disseminated to teachers in the field.

However, the introduction to the former infants mathematics curriculum for Northern Territory Aboriginal schools does have a section entitled "Related Research: Implications for the school". Only the studies of conservation ability by deLemos (1966) and Dasen (1970) are quoted, and the resume ends with a quotation from Dasen, who says his study shows that a large proportion of Aboriginal children do not reach the concrete operational stage of cognitive development, and that this means they will not be able to reach the stage of formal operations, which is thought to be indispensable for secondary education (Infants Curriculum 1974).

Unfortunately, most research studies related to the education of Aborigines have started from the viewpoint of English speaking people in a Western European culture. There is very little published information which gives the Aboriginal viewpoint, but a few studies of this kind are now forthcoming. For example, Judith Stokes' *Description of the Concepts of Groote Eylandt Aborigines* is in preparation for publication. This covers pure and applied number from the point of view of the Anindilyakwa people at Groote Eylandt.

In a major study recently completed, John Harris (1979) also presents the point of view of the Anindilyakwa people, including sections on pure and applied number. It is hoped that some abridged portions of his work will be published in 1980.

It is important for the future of Aboriginal education that more studies like these two should be completed and that they should be made readily available to classroom teachers and trainees preparing to teach Aboriginal children.

The National Curriculum Development Centre in Canberra has recognised this need, and during 1979 initiated a national research project to gather information that will help teachers to understand better their task of teaching mathematics to Aboriginal children. A description of this project is in Appendix A. The focus will be on schools in Aboriginal communities where the life-style is still fairly traditional, and English is not the children's first language, but it is expected that the findings will also be relevant to English speaking Aborigines in ordinary schools in the wider Australian community.

In the meantime, there are some studies done in other traditional cultures which are very helpful. Probably the best known of these is Gay and Coles' (1967) *The New Mathematics and an Old Culture,* a study of learning among the Kpelle of Liberia in West Africa. This was recommended to teachers of Aborigines in Holm and Japanangka's (1976) article about the mathematics of card playing in an Aboriginal community. Another useful study is Prince's (1969) *Science Concepts in a Pacific Culture* which describes Piagetian studies done in Papua New Guinea and, among other things, covers local ideas about quantity, weight, length, area and volume. Having been in the situation himself, Prince understands the problems which teachers face when suddenly confronted with a class of students from a very different culture. He does not just describe his studies; he also tries to suggest what the classroom teacher can do about the findings.

CHAPTER 3

MATHEMATICS CURRICULA FOR ABORIGINAL SCHOOLS

". . . within the same language, and between human beings, the process of understanding each other is a constant process of deciphering, of translation . . . Language multiplicity . . . is one of the great schools of enrichment and of tolerance . . . No two human beings ***speak*** *the same experience of life."*

(Professor George Steiner, in a radio interview.)

CHAPTER 3

MATHEMATICS CURRICULA FOR ABORIGINAL SCHOOLS

3.1 Northern Territory Aboriginal Schools Using English as the Medium of Instruction

Pilot Mathematics Program

Late in 1972 a mathematics workshop was conducted in Darwin with the aim of producing a pilot mathematics program for Aboriginal schools. This writer was involved in drafting the infant school section (Level 1) along with two other teachers and an education adviser. Similar groups of four people worked on Levels 2 and 3.

The instructions for the infants group implied, and those for the Level 2 and 3 groups explicitly stated, that the pilot program for Aboriginal schools should approximate to the South Australian mathematics course for the same grades. Participants in the workshop were also instructed to incorporate in to the program "features unique to Aboriginal culture where these are considered appropriate" (Terms of Reference, 1972).

However, there was very little discussion of Aboriginal culture. Various other curricula were consulted, primarily those for South Australia and Western Australia, and the main task seemed to be to take the current curriculum (S.A. Mathematics Course for Primary Schools), and rearrange, reduce, simplify, delay or omit those parts of the course which had been found to be especially difficult or irrelevant to Aboriginal pupils. Although this was helpful to some extent, it did not tackle the fundamental problem which is that Aboriginal children are expected to work from a mathematics curriculum that is basically designed for use by urban white Australians whose first language is English. The program written at that workshop was published in the *Infants Curriculum 1974* and the *Mathematics Pilot Programme 1974, Levels 2 and 3*. It has been in use from then until now with varying degrees of acceptance.

New Western Australian Mathematics Syllabus

In the last two years there has been an increasing emphasis in the Northern Territory on having officially recommended curricula. In line with this policy, it was recommended during 1979 that all primary schools in the Northern Territory should adopt the new *Western Australian Mathematics Syllabus with Notes*. Aboriginal schools which already had an established mathematics program based on the content divisions of the pilot mathematics program were not required to change, but it was recommended that Aboriginal schools not meeting this criteria should adopt the Western Australian syllabus from the beginning of the 1980 school year, along with the urban schools. This syllabus, which was written with both urban and Aboriginal schools in mind, stresses the need to use concrete materials, and to learn through activities, and was thought to be the most suitable syllabus currently available. Teachers from Aboriginal schools who have attended in-service courses on the use of the syllabus have been very enthusiastic about it, and some schools on Aboriginal missions and reserves have begun using it.

At first, the inservice courses and further development of materials associated with the syllabus will be the same for both non-Aboriginal and Aboriginal schools, but staff in the mathematics unit in Darwin expect that within two or three years they will have the information and resources available to properly assess the need for adaptations to the syllabus to cater for the different needs of Aboriginal children. By that time, teachers in Aboriginal schools will know more about the problems and advantages of using this syllabus in their situation, and the recommendations and information coming from the national Curriculum Development Centre project mentioned earlier should be available, giving a much sounder basis than at present for making decisions about the development of special programs.

3.2 Northern Territory Aboriginal Schools with a Bilingual Education Program

Out of over 70 Aboriginal schools in the Northern Territory, at least 15 have bilingual education programs. Several of these programs have been in operation since 1973 and have reached the stage where the staff feel that, as the vernacular and English language and reading programs are progressing well, they can now give more attention to developing a mathematics program.

Which language should be used as the medium of instruction for mathematics?

Often, the first problem to be tackled in a bilingual mathematics program for Aborigines is the question of appropriate vocabulary in which to express the Western mathematical ideas which are not a part of the traditional culture and therefore not a part of the language. Aboriginal languages have expanded their vocabularies to include many new ideas introduced by Europeans, but there remain many specialised terms and ideas which are so far removed from the traditional culture and thought patterns of Aborigines that it is extremely difficult to express them unambiguously in the Aboriginal language.

All languages change to meet new demands. In order to express new ideas, people in societies undergoing cultural change automatically borrow words from other languages, make up new words, and attach new meanings to old words, but sometimes this process of language evolution needs to be accelerated. This is sometimes done through language planning on a national basis, such as when the governments of Indonesia and Malaysia took deliberate steps to modernise and standardise their national languages (Alisjahbana 1971).

There are various ways to modernise and expand the vocabulary of a language. They are often referred to by the general term *language engineering*. In their recommendations concerning bilingual education in the Northern Territory, Hale and O'Grady recommended using the principles of language engineering in Aboriginal languages to fill out the system of cardinal numbers, to develop expressions for zero and ordinal numbers (where these do not exist), and to develop ways of talking about fractions, number relationships, square root, and so on. In making this recommendation, they remind the reader that it is their view that "Bilingual Education has the goal of enabling an Aboriginal scholar to write or talk about literally any subject under the sun either in English or in his native tongue" (Hale and O'Grady, 1974).

Not everybody agrees with the view of these two linguists. Some take the view that in a bilingual program each school subject should be taught in the language most appropriate to the subject matter, and that in Aboriginal schools English is obviously the most appropriate language for teaching mathematics. While this may be true for older children who have achieved a reasonable grasp of the English language, it can seriously jeopardise the younger child's chance of grasping the important basic concepts on which later learning of mathematics is built. The young child will be forced to learn foreign ideas in a foreign language which he has barely begun to speak, and will probably see little connection between his everyday life and the words and formulas which he rote memorises at school.

So there are three important questions of language policy which staff in bilingual Aboriginal schools must tackle at an early stage of developing a mathematics program. They are -

1) in which language will instruction in mathematics be initiated? - the vernacular or English?

2) if instruction is begun in the vernacular, how much can or should the language be expanded to deal with mathematical terms and relationships, and at what stage should a transition be made into instruction in English?

3) if instruction is begun in English, which is being taught as a second language at the same time, how can the problems of the child's lack of fluency in the language of instruction be overcome?

In his article, *"The role of language in learning mathematics"*, Robert Morris (1978) touches on each of these questions. Having discussed what mathematics is, and having made the statement that "linguistic fluency is vital to success in mathematics" (p.75), he then asks "In what language?" His answer is that common sense would suggest that the children's mother tongue is the obvious choice. Unfortunately in practice the choice of language of instruction is neither obvious nor easy. Morris goes on to explain how the national language development policy and the national educational policy each influence decisions about using a minority language as the medium of instruction. In Australia, the educational policy would no doubt be the stronger influence, as a national language policy has not been fully developed yet.

Using the vernacular to teach mathematics

For those who wish to use the vernacular for teaching mathematics in the early stages, as a number of Aboriginal bilingual schools have decided to do, Morris suggests three ways to expand the mathematical vocabulary.

One way is to take words already existing in the language and to give them a special meaning in a mathematical context. Examples in English are words like 'product', 'power', and 'root', and there are already many examples to be found in Aboriginal languages. A word meaning 'stone' may be extended to refer to 'hard cash', i.e. coins; a word meaning 'dark red colour' may in modern life also refer to '5 dollars', and 'turtle egg' might be chosen to talk about 'a circle'.

There are two main problems associated with this kind of redefinition of words. Firstly, the meaning may not be precise enough for mathematical usage. Secondly, until the extended meaning of the word is accepted and used throughout the community, its meaning in a mathematical context might not be clear to all speakers of the language.

Another method of expanding the vocabulary is to combine two or more ordinary words, and give the combination (known as a 'locution') a special meaning (Morris 1978, p.78). Examples in English are 'prime number', 'perfect square', and 'golden rectangle'. Examples found in bilingual schools include a phrase meaning 'long sharp points' used for 'diamond'. and a phrase meaning 'like a door' used for 'rectangle'. Unfortunately, as Morris points out, such phrases are often imprecise in their meaning, and can be quite lengthy and awkward to use. Teachers should remember, however, that Aborigines are much more accustomed to long words and phrases than English speakers are, and Aboriginal teachers should be the ones to decide when a word or phrase in their language is too long and awkward to use in teaching.

When other methods fail, Morris regards it as "the obvious way forward . . . to borrow from another language and to spell the word in accordance with the phonetic characteristics of the borrowing language" (p.79). He gives examples of Lesotho nationals in Africa borrowing English words like circle, triangle, and quarter, and writing them in their language, Sesotho, as *sekele, teraeankele,* and *katara*. In a similar way, Vaszolyi, in his book *Aboriginal Australians Speak,* says that a common way to expand the vocabulary of Aboriginal languages is to borrow from English (Vaszolyi, 1976, p.45). His examples are drawn from everyday life - *mitjin* for 'mission', *kultitja* for 'schoolteacher', and so on, but there are many examples of this kind of borrowing being used to enlarge the mathematical vocabularies of Aboriginal languages. Sometimes the English words are already in common use in the community, although pronounced differently according to the phonetic patterns of the Aboriginal language, and then the Aboriginal teachers and other people involved just have to decide how to write the words in their own orthography (the letters or combinations of letters with which they write their language). At other times, the suggestion to borrow and transliterate English mathematical terms may originate in the school and then be tested for acceptance in the community. The bilingual school programs at Yuendumu (Warlpiri language) and Goulburn Island (Maung language) provide examples.

At Yuendumu, Warlpiri adaptations of the names of the months of the year and the days of the week were already in common use in the everyday speech of the community. Early in the bilingual program development, the Warlpiri teachers, as a matter of course, worked out how to write down these words in the Warlpiri orthography, and began using them in routine teaching about time in the bilingual classes. They have remained in use and are accepted to the extent that the Warlpiri people now have their own illustrated calendar, the *Warlpiri Kalinta,* which uses the borrowed names for days and months in much the same way that a modern Indonesian calendar does. Examples can be found in Appendix B.

At Goulburn Island, the Maung teachers had tried various kinds of language engineering based on new uses for traditional Maung words. They had found the engineered terms to be rather cumbersome and sometimes imprecise, and had discontinued using them, but were still most anxious to have "really Maung" vocabulary for teaching mathematics. They did not want to use English. They were interested when a visitor showed them the *Warlpiri Kalinta* and explained how English words which were already an accepted part of the *speech* of the community could also be *written* as Maung words, using the same phonemes and syllable structures that they would use when pronouncing the word in a stream of Maung speech. Later, at a special staff meeting, the Aboriginal teachers agreed upon words for colours, shapes, numbers to 20, days of the week and months of the year, following language engineering principles. They proposed to use these words in vernacular instruction in the infants classes. They were excited about their new vocabulary, and planned to develop more Maung vocabulary based on English words for which they have no equivalent.

Of course, agreeing on mathematical vocabulary for use in the school program is only a first step. The terms must be refined through usage, and years must pass before it is known whether they will become fully accepted in the speech and literature of the Maung people, in the same way that borrowed words like 'algebra', 'data', 'zero', and so on, have been incorporated into the English language.

Using English to teach mathematics

Morris looks at second-language mathematics instruction from the point of view of the child who has begun instruction in the vernacular and is progressing to use of the second language which he has previously learned as a foreign language. He makes the point that "there is a tendency in second language courses to concentrate on the social uses of language rather than the scientific" (p.80), and suggests that early language teaching courses should be carefully scrutinised for their mathematical and scientific content. Learning anything in a second language is difficult, and special teaching techniques are needed, but Morris points out that the problems are accentuated when mathematics is the subject. "This is due", he says, " . . . to the abstract nature of mathematics, and the difficulties which arise in absorbing abstract concepts. Also the language used has to be precise, consistent and unambiguous, if mathematical ideas are to be explored and described effectively". In order to explore, describe and discuss mathematical ideas the child must be equipped with a basic repertoire of linguistic concepts and structures. The child who learns in his mother tongue will have these, "but for the child who has to begin to learn in a second language, whether on entering school or later, the linguistic concepts and structures have to be taught" (Morris, p.80). "In short", says Morris, "the teaching of mathematics in a second language must, in effect, adopt the principles which govern the methods of teaching a second language as a language" (p.81).

This has implications for teacher training. Teachers of tribal Aboriginal children should not only have a sound knowledge of the principles of teaching English as a second language; they should also understand that the same principles apply in the context of teaching mathematics and science, and for that matter, any other subject they teach.

Language problems are just the tip of the iceberg

Although I have dealt at length with problems of language, specifically the problem of gaps in technical vocabulary in Aboriginal languages, I do not wish to give the impression that these are either the most important or the most difficult problems encountered in developing mathematics programs for Aboriginal schools. Language problems are just the tip of the iceberg - spoken language is part of the surface structure of culture which is obvious to everybody. As has been noted earlier in the section on mathematics in Aboriginal society, gaps in vocabulary can relatively easily be filled. But these differences between Aboriginal languages and English are indicative of the vast differences between the world views of Aboriginal people and the world views of the English speaking Australians who control the education system and write the mathematics programs.

Those unfamiliar with the term *world view,* are referred to Vaszolyi's paper *Language and World View in Aboriginal Australia* (1977). He gives his definition of world view in the Aboriginal context, and points out how the Aboriginal world view developed against a specific economic and social background: that of a semi-nomadic hunting and food-collecting society which was necessarily highly mobile, attuned to nature, and non-acquisitive.

It is impossible to pinpoint one particular area of life in which the Aboriginal and white Australian world views are most different, but where school subjects are concerned, mathematics and science must come near the top of the list. The fact that nearly all of Vaszolyi's examples are mathematical - concerned with different concepts of number, time and distance - is indicative of the differences which exist in the mathematical area.

The difference in world view is also highlighted in a linguistic paper on directional terminology in Warlpiri by Dr. Mary Laughren, linguist to the Warlpiri bilingual education program at Yuendumu in Central Australia. I quote:

> Now while Number is considered basic and primary to the conventional European view of Mathematics and hence European children are introduced to counting at an early age and in fact the ability to count up to certain numbers is taken as a sort of intelligence test, it is also true that Mathematics covers other fields such as directional, spatial, temporal measurement and relations. It is mastery of these which is valued by the Warlpiri, and their children's ability to handle directional and spatial terminology in particular is taken as a sort of intelligence test similar to the counting prowess test amongst Europeans. Warlpiri children of 3, 4 and 5 handle directional terminology (up, down, on, under, hither, thither, here, there, etc) including the points of the compass and positions and directions relative to the points of the compass with ease and competence. (Laughren, 1978)

She contends that an infants school mathematics program for Warlpiri children would do well to concentrate on reinforcing and refining this directional and spatial aspect of the child's knowledge "before plunging him into a Number orientated Mathematics programme" (p.2). The data which Laughren presents appear very complicated to a naive non-linguist, and indeed Warlpiri directional terminology is complex and extensive, but she feels that "It is up to educationalists to try and absorb this sort of data in order to create appropriate school programmes" (p.15).

CHAPTER 4

WHO HAS FAILED: THE CHILD OR THE SCHOOL?

". . . human beings who misunderstand one another, and who are serious about this problem, are . . . human beings caught in the process of learning; caught in the process of changing their own narrow assumptions about something vital in order to reach the assumptions of the other."

(Professor George Steiner, in a radio interview.)

CHAPTER 4

WHO HAS FAILED: THE CHILD OR THE SCHOOL?

Up until now, the mathematics curricula used in most Aboriginal schools appear to have been based on the assumption that the tribal Aboriginal child's *need* for mathematics learning is similar in kind to that of any other child anywhere in Australia. The difference, it is often suggested, is in the Aboriginal child's *ability* to learn mathematics.

The literature consulted makes very few challenges to this assumption in its explicit references to school mathematics. However, some comments about school performance in general are applicable, and should be noted.

For example, the anthropologist, von Sturmer, writing about the educational process in two Aboriginal settlements in Cape York, talks about the dissonance between school learning and community life, and says "it seems clear that a confusion must be removed: education for living in an Aboriginal community is not and should not be the same as for living in Western society" (1973, p.15). "The sort of knowledge being taught in the school", he says, "has little to do with the sort of knowledge required by the society in which the school is placed" (p.13). As a result "perhaps more than anyone else . . . the teacher symbolises the strangeness and remoteness of Western knowledge" (p.12). Teachers, as a result, are inclined to make sweeping generalisations about Aboriginal ability "because they are forced into the position of having to explain to themselves why the techniques that they employed so successfully, outside, with white children, so obviously fail with their Aboriginal classes" (p.13).

Bishop, who was at the time Curriculum Specialist (Mathematics) in the Northern Territory, noted in the December 1973 issue of *The Aboriginal Child at School* (1:4) that the home and school in Aboriginal communities are two distinctly different social systems, and that it may well be that much of the mathematics a child learns in school is school-bound. Since it cannot be assumed that school learnings will transfer across to the community, Bishop suggested that teachers need to "take seriously the challenge of enriching the home backgrounds of the children they teach" (p.17).

The suggestion that white teachers need to enrich the home background of their Aboriginal students seems to imply that there is a deficiency in the child's home life which the teacher, with some superior knowledge, can correct; an environmental lack for which the teacher can compensate. This idea is similar to the *cultural deprivation* approach which was followed in some compensatory preschool programs for minority groups in America. The programs, referred to as Headstart were aimed at alleviating the effects of being in an unstimulating environment.

Kelly and McConnochie (1975), in their provocative article *Compensatory Education: A subtle form of racism?,* question this and other common assumptions about causes of school failure in minority groups, and suggest that instead of looking at environmental and genetic factors related to the minority group, the dominant white culture should look critically at its own educational institutions in order to consider ways in which these might be contributing to minority group failure. The writers claim that *institutional failure of schools* is a source of environmental variance which has been understated in attempts to explain the disproportionate failure of Aborigines and other minority groups in Australia.

The writers of the ACER report referred to earlier realised that the differences in performance between Aboriginal and other children were not simply attributable to differences in ability. They had set the tests on the assumption that the tasks included would have been experienced by the students "either in the course of their schooling or their everyday life" (Bourke and Parkin, p.150). This did not prove to be the case. The report is dotted with comments like "it is unlikely that the type of problem set was within their experience" (p.148). The writers were forced to conclude that "the expectation that almost all students would have experienced the types of tasks set cannot be supported for students at Aboriginal schools in the Northern Territory" (p.151). They then question whether such students should be required or would ever desire to lead the kind of life which was assumed in the tests, and suggest that, for some students at least, the requirements of the tests would have been largely irrelevant (p.153). That the tasks were indeed largely irrelevant to tribal Aboriginal students is strongly supported in the research about to be described.

PART TWO

MEASUREMENT IN TRIBAL ABORIGINAL COMMUNITIES: A RESEARCH REPORT

> ***measure*** **v.t. & i.** ***Ascertain extent or quantity of (thing) by comparison with fixed unit or with object of known size; ascertain size and proportions of (person) for clothes.***
>
> **(Concise Oxford Dictionary, Fifth Edition)**

CHAPTER 5

RESEARCH DESIGN

> *"Questionnaire design cannot be taught from books; every investigation presents new and different problems."*
>
> (Preface to Oppenheim, 1966)

CHAPTER 5

RESEARCH DESIGN

5.1 Choosing the Topic and Method

The survey carried out in relation to this study was based on one conducted by Jones at the Educational Research Unit of the University of Papua New Guinea and described in two publications - *E.R.U. Research Report No. 12* (September, 1974) and *E.R.U. Research Report No. 19* (October 1976). The first of these reports, entitled *Quantitative Concepts, Vernaculars, and Education in Papua New Guinea,* was used as the basis for the present study.

Jones, acknowledging the importance of language as "an indicator of conceptual development and environmental perception" (1974, p.5) conducted a survey into the extent to which vernaculars are capable of dealing efficiently with various basic science concepts, quantitative terms, and relational terms. His questions were mainly linguistic in nature, although they were directed towards educational problems.

It seemed convenient for the purposes of this present study to adopt his method of using questionnaires, but it was decided to confine the enquiry to the concepts, the language, and the use of *measurement,* for the following reasons.

1. To keep the study within manageable proportions it had to be limited to one aspect of mathematics.
2. The study of measurement is an important aspect of the mathematics course for Aboriginal schools in the Northern Territory. The introduction to Level 2 of the *Pilot Programme 1974* states that "the carry over of pure mathematics to applied areas must rank as the most important reason for using all mathematics in the life of our students" (p.2).
3. It was true of the writer's own experience in an Aboriginal school that more emphasis was placed on teaching applied number than on pure number, and this seemed appropriate.

5.2 The Questionnaire

Compiling the questionnaire

At the time of commencing the study, no copy of Jones' actual questionnaire was available, but most of the questions were set out in his report and others could be inferred from the context. These were collated, modified slightly, and rearranged and numbered for more efficient use. A section on Money was added because of its importance both in the mathematics curriculum, and in the everyday life of an Aboriginal community. There was debate as to whether the questions relating to area and volume should be cut out of the questionnaire because of their seeming irrelevance to Aboriginal life. However, as one aim of the questionnaire was to test the (ir)relevance to Aborigines of the concepts covered, these topics were included.

In the end, nine topics were selected. These were Length, Height, Distance, Time, Speed, Weight, Area, Volume and Money. The progression of the topics and the concepts covered in the questions were such as might seem to a Western-oriented curriculum designer to be basic to the study of measurement, although not exhaustive in that respect. (See copy of questionnaire in Appendix C.)

Progressive drafts of the questionnaire were discussed with Dr. Barry Blake, senior lecturer in linguistics at Monash University, and with Mrs Heather Hewett, a United Church linguist working in the Maung language at Goulburn Island. Partly on the basis of their comments, the questions were further modified and supplementary questions were inserted in the comments column to guide discussion. The writer was concerned that the questionnaire should have been more extensively piloted but this was quite impossible, given the limitations of time, distance and poor mail services.

Mailing the Questionnaire

Most of the questionnaires were sent to linguists, as it usually happens that linguists remain in the same Aboriginal community for a longer time than the average teacher, and, because of the nature of their work, have a deeper knowledge of the language and customs of the Aboriginal people. Almost all of the people approached were known to be involved, either directly or indirectly, in a program of education in an Aboriginal school, often as the teacher-linguist or consulting linguist in a program of bilingual education. In most cases the questionnaire was completed in collaboration with one or more Aboriginal persons who spoke the Aboriginal language as their mother tongue. Each linguist represented a different Aboriginal language, with two exceptions. The Warlpiri and Anindilyakwa languages were covered twice, in each case by two people who worked in different areas where the language is spoken.

Most of the questionnaires were posted during May but some were sent later, as other possible recipients were suggested. Early in July a follow-up letter was sent to some recipients who had not yet replied.

5.3 Languages and Localities Covered

The following information, obtained from the completed questionnaires, is shown in Appendix D.

(a) The name of each language for which a reply was received.

(b) The language family, group and sub-group.

(c) The type of language.

(d) The approximate total number of speakers.

(e) The name(s) of the school(s) where a significant proportion of pupils speak that language as their mother tongue.

(f) *The extent to which the language is used as a medium of instruction at school, if at all. It should be noted that this information is presented in the way that it was given by the respondents to questionnaires in 1977. The situation at some schools will be different now.*

The languages are grouped according to family, group and subgroup. Where there were any doubts regarding classification of languages or other linguistic details, Wurm's *Languages of Australia and Tasmania* (1972) was taken as the final authority, except in regard to the spelling of language names, where the spelling given by the respondent on the questionnaire was used in preference to any alternative forms.

CHAPTER 6

RESULTS

"People 'measure' via means of a mental picture, or by 'eye'. There's hardly anyone here who can't buy a dress for a relative by simply looking at the dress. They nearly always buy the correct size."

(Statement by Chris Kilham, linguist with the Wik Munkan tribe.)

CHAPTER 6

RESULTS

6.1 Response to the Questionnaire

6.1.1 Number Returned

Of the 28 questionnaires sent out, 22 were returned completed. Four recipients wrote giving reasons why they did not complete the questionnaire, and only two did not reply at all. Appendix E shows the following information relating to each questionnaire which was returned.

(a) the name of the person who completed the questionnaire and, where given, details of people, Aboriginal or non-Aboriginal, who assisted

(b) the location of the person who completed the questionnaire

(c) the full name of the language

(d) the abbreviation that will be used when referring to that language.

Appendix D gives more extensive details about the languages themselves and where they are spoken.

6.1.2 Delays in Return of Questionnaire

The first questionnaires were sent out early in May, and the last returned was received in August, almost three and a half months later. The following three factors were responsible for most of the problems experienced in getting the completed questionnaires back within the required time, and these need to be taken into account in any similar research projects in the future.

Slow Mail Service

First, the very poor mail services meant that questionnaires were a long time in transit in either direction. One respondent reported that the questionnaire took sixteen days to get from Melbourne to her location in Arnhem Land.

Absence of Linguist

A second point to remember is that, for a variety of reasons, a linguist may frequently be absent from his or her location. For example, 18 linguists working in Aboriginal languages were at a linguistic workshop in Darwin during July-August 1977, and during the preceding weeks were under pressure preparing their material.

Demands on Linguist's Time

Third, the questionnaire was very long, and from comments received, it is estimated that most respondents took three to four hours at least to complete it. The amount of time taken would have depended, among other things, on the linguist's familiarity with the language, whether or not he or she worked with an Aboriginal language helper, and the degree of linguistic sophistication of the language helper.

This is a lot to ask of people who, because of their special skills, have a great number of similar requests to do language work which is not directly related to their employment. As one person said in reply, "I just get things sent from everywhere".

6.1.3 Reactions to the Questionnaire

About half the respondents returned the completed questionnaire without any comment, but some made comments about the content and design of the questionnaire, either on the questionnaire itself or in accompanying letters.

Relevant and Helpful

Of those respondents who did comment, six said they found it helpful, interesting, or relevant, especially for bilingual schools. Four asked for a photocopy of the completed questionnaire to be sent back to them, so that they could continue to build on the information it contained.

Negative, because based on Western European point of view

Two linguists offered helpful criticisms. They pointed out that, because the questionnaire started from a Western mathematics point of view using English stimulus sentences, it gave very little opportunity for the respondents to show how concepts are expressed in the vernacular, although in a different way from how they are in English. They said that some of the Aboriginal helpers had found it very discouraging that the Western cultural bias of the questions forced them to give a large number of negative replies such as "No we do not have a term like that", or "No, we would never want to say that". Taking up this point, I later wrote an imaginary Aboriginal questionnaire for English speaking people. A description and samples from this questionnaire are shown in Appendix F. The aim was to show how culturally biased questions may sometimes achieve little more than to show that the questioner and the respondent do not share the same point of view.

It was suggested by one linguist that a better type of question for this survey might have been something more general like "How do the people talk about length? In what situations would they need to compare lengths? Are there any situations in everyday life where precise measurement of length would be important?", and so on. Some questions of this type were included in the column for further comments, but Yes/No and rating questions were used for the main part of the questionnaire so as to minimise the amount of writing required of the respondent, and facilitate the collation of the answers.

Difficulties in following instructions

Another linguist said she had found some of the instructions difficult to follow. One point of confusion was the distinction made between sentence *structure* in instruction 2.2 regarding adapting the English stimulus sentence to the local situation, and sentence *meaning* in instruction 3.2 regarding how to rate the difficulty of expressing the meaning of the English stimulus sentence in the vernacular. The instructions were:

> 2.2 Sentence Structure
>
> To make sure that all respondents to the questionnaire give a difficulty rating for the same basic sentence, it is important not to alter the structure of the English sentence given. Therefore, when considering how to make the questions more relevant to the situation, DO NOT CHANGE THE BASIC STRUCTURE OF THE ENGLISH SENTENCE FOR WHICH YOU ARE GIVING A DIFFICULTY RATING.
>
> (It is understood, of course, that the sentence structure will usually be different in the vernacular translation.)
>
> 3.2 Difficulty Rating Questions
>
> In these questions, you are asked to assess the degree of difficulty of expressing in the vernacular the sentence given in English. A rating of 1 means that it is quite easy to express the meaning in a relatively short, simple vernacular sentence which clearly carries the same meaning as the English sentence. At the other end of the scale, a rating of 7 indicates that it is very difficult, almost impossible, to clearly express in the vernacular the meaning of the English sentence given.
>
> GIVE A RATING RANGING FROM 1 FOR VERY EASY SENTENCES TO 7 FOR SENTENCES THAT ARE ALMOST IMPOSSIBLE TO TRANSLATE.

The writer's reason for including instruction 2.2 was to preserve the distinction between questions like L3 and L3.1:

> L3 The length of the (piece of ground; rope; cloth) is (a number of local units of measure).
>
> L3.1 The (piece of ground) is equal to (a number of local units for measuring length).

In consecutive questions of this type, the second question was sometimes inserted with the aim of seeing whether the difficulty rating would be different if the basic English stimulus sentence were worded slightly differently.

Apparently it was not clear that instruction 2.2 referred to the English stimulus sentence only, as it was evident from several questionnaire replies that the respondents had taken the instructions to mean that they should look for vernacular statements that were equivalent in both meaning *and structure* to the English sentence given. This was not intended. Perhaps the statement made in brackets at the end of instruction 2.2 (i.e. that it was understood that the sentence structure would usually be different in the vernacular) should have been emphasised more, and examples should have been given to illustrate what was meant by the instruction not to alter the structure of the English sentence. However, the problem in writing the instructions for completing the questionnaire was to keep them concise while at the same time making them as explicit as possible to reduce the subjectivity of the responses.

6.2 Responses to Standard Questions

Explanation of different types of questions

A distinction was made between *Standard* and *Miscellaneous* questions. Standard questions were those which were repeated with the same format in all or most of the topics. They constituted about three-quarters of all the questions asked. For some standard questions a supplementary question was added that took a different approach to the question, or called for further information on the same question.

The remaining questions were classed as Miscellaneous. These were usually applicable only to the topic in which they occurred. For the purposes of this report, Type 9 questions, which invited free comment on the use and teaching of the concept covered in each topic, are also regarded as miscellaneous.

Because of the limitations on the size of this report, it deals only with the responses to the basic standard questions, and does not cover responses to supplementary or miscellaneous questions.

Concepts covered in standard question types

Eight main question types were used, and these were defined as follows.

Type 1: Availability and use of *abstract terms.*

Type 2: Availability of *local units* of measure.

Type 3: Use of *local units* of measure.

Type 4: Understanding and use of *standard units* of measure.

Type 5: Equivalence statements of the type $A = B$.

Type 6: Equivalence statements of the type $A + B = C$.

Type 7: Ways of expressing the *comparative,* e.g. 'longer'.

Type 8: Ways of expressing the *superlative,* e.g. 'longest'.

Introduction to summaries

Following are summaries of responses to the eight standard question types. Each summary shows

(a) the standard format of questions of that type,

(b) a table summarising the answers to questions of that type, and

(c) a representative sample of respondents' comments, quoted verbatim.

An abbreviation is used to indicate the language to which each comment refers (see Appendix E).

Two additional summaries compare

(a) the difficulty ratings given for the different question types,

and

(b) the difficulty ratings given to standard questions under the different topics.

As the last three questionnaires were received after the results had already been collated and summarised, it was not possible to include their responses in the weighted mean difficulties of the questions for which difficulty ratings were given. However, their written comments and answers to Yes/No questions are included along with all the others.

It will be noted in the tables that the number of responses is not constant. This is because respondents occasionally missed a question altogether, or made a comment only, without giving a rating or Yes/No answer. Also, where the answer given was in any way unclear or ambiguous, it was not included in the summary table.

6.2.1 Responses to Questions Requiring a Yes/No Answer

TYPE 1 QUESTIONS

These were of the form:

Does the language have an abstract term equivalent to the English word ________, as in ___________________?

Table 1 summarises the answers to these questions.

Table 1

Number of negative and positive answers to Type 1 questions

Abstract term	Answer	
	Yes	No
Length	3	18
Height	1	19
Distance	3	19
Time	7	12
Speed	-	17
Weight	1	19
Area	2	18
Volume	-	20
Money	22	-

From this table it can be seen that, with the exception of time and money, there are almost no abstract terms referring to the areas of measurement covered in the survey. This statement should be taken at face value. It simply means that Australian languages as a general rule do not have abstract terms equivalent to those in English. It does not imply that Aborigines are therefore unable to discuss length, height, distance, etc. They merely do it in a different way. However, the lack of abstract terms could be an indication that such measures are unimportant in Aboriginal life, which is borne out by the answers to subsequent questions. A close examination of the questionnaires suggests that a few of the Yes answers could, on further investigation, prove to be the result of a misunderstanding of the question, but this is certainly not true of all of them.

Respondents offered no additional comments on any Type 1 questions under the topics of Length, Distance, Speed, and Volume. Comments under other topics are presented below.

Respondents' Replies to Type 1 Standard Questions

HEIGHT *H1* *Does the language have an abstract term equivalent to the English word 'height' as in the question "What height is it"?*

No "How long?" is used for height and length, applied to people and features of the landscape. (Nya)

No Edward River compare height and distance by lengthening the first syllable of the locative word.

ikan	'on top'
iikan	'higher'
yuu-*kan*	'far up'

(K-Th)

TIME *T1* *Does the language have an abstract term equivalent to the English word 'time' as in the sentence "It takes a long time"?*

Yes Traditional term. Word also means 'place, location', e.g.

Aak in yaam kuup.amp ey?
time this long wait we ques
'We're waiting a long time, ey?'

Aak kan wamp.ant
time punct. come -
'The time has come for ______' (Wik)

Yes Traditional term. *raak* 'time, place, things' (according to context) (K-Th)

No but we have words meaning 'long time' and 'short time'. (Tiwi)

WEIGHT *W1 Does the language have an abstract term equivalent to the English word 'weight' as in the sentence "What weight is it"?*

No There is a word meaning to 'weigh down' or 'prevent rising', but not an abstract term for weight. (Nya)

AREA *A1 Does the language have an abstract term equivalent to the English word 'area' as in the question "What is the area of the land you want"?*

No The English word 'area' is commonly used. (Anin)

No Each separate area of land has a name. (K-Th)

MONEY *M1 Is there a general term for money?*

More than half of the respondents reported the use of a word meaning "stone". About half also said that the English word had been taken into the language, usually manifesting itself as *mani* or *maniyi,* used either exclusively or in conjunction with another term. *Rrupiya,* a term introduced by the Macassans, derived from Indonesian *rrupi,* was mentioned by four respondents, and words for 'shell' were mentioned by two. In Iwaidja the term *galgirrirr* is used, which seems to mean 'metal'. Six respondents gave separate terms to distinguish coins and paper money. Four of the terms for paper money either used the name of a variety of paperbark tree, or referred to the skin or bark of a tree. In Anindilyakwa the word *amujurra* is used at Umbakumba for paper money. This is derived from *jurra,* a Macassan word denoting 'book' or 'paper', which is also used in Maung on Goulburn Island.

TYPE 2 QUESTIONS

These were of the form:

Are there any local units for measuring______________?

Table 2 summarises the answers to these questions. Again, the Yes answers are open to different interpretations. For example, three respondents answered Yes to the question "Is there any countable unit of time smaller than a day?" (T2). Of these, it is evident from the comments of two that they were referring to *points of time,* not *countable units* of time. Their comments were therefore transferred to TM4, which deals with points of time, and their responses are not shown in Table 2. Jones (1974), in his similar study, also found that most respondents replied in the affirmative to this question, although it was clear from the examples given that they were referring to specific points in time. For this reason, a note was added to question T2 in this questionnaire, pointing out that it did not refer to points in time such as sunrise, midday, afternoon, etc.

Table 2

Number of negative and positive answers to Type 2 questions

Local Units	Answer Yes	Answer No
Length	2	19
Distance	-	22
Time	1	19
Weight	1	20
Area	2	17

The one Yes answer which is recorded for Time in Table 2 came from the respondent for the Tiwi language. The only information given is as shown in the quotations below, viz, that it is "an hour" and that the word for sun is used. More information is needed to know whether or not the reported Tiwi unit of time conforms to the criterion given in the question that it should be a countable unit.

Possibly the only true example of a local unit of measure which was given in response to Type 2 questions is that shown below under Weight reported by the respondent for Nyangumarta (Nya).

Respondents' Replies to Type 2 Standard Questions

LENGTH L2 *Are there any local units for measuring length which are in general use, for example, hand-spans, spear-lengths, or specific lengths of rope?*

Yes Foot lengths - used when fencing. 5 (hand held with fingers spread). Feet (measured toe to heel) between fence-posts, and/or strainers. (Nya)

No People "measure" via means of a mental picture or by "eye". There's hardly anyone here who can't buy a dress for a relative by simply looking at the dress - they nearly always buy the correct size. (Wik)

No point out real length with reference to visible points. (Warl)

Yes *marakap nganajpa* 'one length of dugong rope', approx. 50 yds. In the old days when someone used to make rope they would say "I have finished one length of rope". It's only used in relation to rope, and is not a precise length. There are also two measurements for material: *arntulyak alan* 'long path' about 9/10 yds. used in measuring material for ceremonial length; *wulurtpuj alan* 'short path' used for dress lengths, about 3 yds. (Ma)

DISTANCE D2 *Are there any local units for measuring distance which are in general use in the community?*
N.B. THE QUESTION REFERS ONLY TO MEASURES OF DISTANCE, NOT TO TIME TAKEN IN TRAVEL.

No Only use "far, very far, quite a long way, etc." (Gu)

TIME T2 *Is there any countable unit of time smaller than a day?*
N.B. This question does not refer to points in time, such as sunrise, midday, afternoon, etc.

No We have a finely graded continuum. (K-Th)

Yes an hour - word for 'sun' is used. (Tiwi)

WEIGHT W2 *Are there any local units for measuring weight which are in general use?*

Yes "fruit"
When mining - large fruit tins (5 lb.) used by individuals.
14 fruits = 1 bag
18 bags = 1 x 44 gall. drum of mineral. (Nya)

AREA A2 *Is there any local method of measuring area?*

Yes Small areas were equated with camp. Each man needs his own camp or area - a space in relation to other families. (Nya)

No An area is indicated by adverbs of position denoting vague boundaries. (Anin)

No I think place and ceremonial importance is the only relevant thing in regard to land - as far as I know size of area is quite irrelevant.

No The term *kantri* (country) is used, but not in any quantitative sense, only as a descriptive term for a region belonging to a clan. Sites are named and linked through clan ownership. Mathematical Area of countries can only be described in European terms. (RoCr)

? Area is measured only in terms of "like______" - an appropriate comparison being found on the spot or in common experience. (Rem)

6.2.2 Responses to Questions Requiring a Difficulty Rating

For each of the remaining standard questions the respondent was asked to give a difficulty rating (see questionnaire and instructions, Appendix C). The results are presented as weighted mean difficulty ratings. The procedure for calculating the weighted mean difficulty is illustrated for Height.

	Rating Value	Number giving that rating	Calculation of Weighted total
Easy	1	1	1 x 1 = 1
	2	0	0
	3	0	0
	4	1	1 x 4 = 4
	5	1	1 x 5 = 5
	6	2	2 x 6 = 12
Almost impossible	7	13	13 x 7 = 91
			113

113 divided by 18 (the total number of respondents who answered that question) gives a weighted mean difficulty rating of 6.28. Thus WMD = 6.28. A WMD of 1 would show that all respondents thought the question was easy and gave it a difficulty rating of 1, and a WMD of 7 would show that all respondents found it almost impossible to express the ideas of the English stimulus sentence in the vernacular, and therefore gave it a difficulty rating of 7.

TYPE 3 QUESTIONS

These were of the form:

The (length) of the __________ is __________ (a number of local units of measure)

Table 3 summarises the answers to these questions.

In view of the negative response to Type 1 and Type 2 questions on the availability of abstract terms and local units of measure, it is not surprising that Type 3 questions, which depend on a positive response to both, were rated as being close to impossible. Note that the lowest difficulty ratings were given for the topics where the abstract term was replaced by a term which is more likely to have an equivalent in the language.

Table 3

Weighted mean difficulty ratings for Type 3 questions. (Where the word used in the stimulus sentence differs from the name of the topic it is shown in brackets.)

Topic	WMD
Length	6.68
Height (high)	6.28
Distance	6.89
Weight (weighs)	6.53
Area	7.00
Volume	7.00

Respondents' Replies to Type 3 Standard Questions

LENGTH L3 *The length of the (piece of ground; rope; cloth is (a number of local units of measure).*

By using English measurements as loan words, you can say something like "This pencil is (± long/short) like 4 inches". (Wik)

The ability of Aborigines to adopt and adapt European terms (correctly suffixed!) is remarkable! (Nya)

The length of a piece of ground is likened to an already known length, e.g. 'A is about the same as B' . . . . . a thing is measured by its similarity in length to something else and not by a standard measure. (Ma)

HEIGHT H3 *The (tree; pole) is (some number of local units) high.*

Height of pole for mast was measured against width of sail. Height of forked stick for shelter selected according to man's height. (Anin)

I do not know of any situation in which it is relevant to measure height. The only unit of measurement is by comparison to what you might expect, e.g. It is very high (for a hill). It is very tall (for that sort of tree) etc. (Ma)

No [situation in which it would seem relevant]. A descriptive phrase would show location or degree of distance. For example -

> *Thad sugabeg im numu haiwan, im jeya la thad branch.*
> 'The sugarbag is not high up, it's there on that branch.' (RoCr)

> [The question is] hard because there are no local units, but it's no problem to say something like 'This tree is high, like 20 feet' however, 20 feet would rarely be understood. (Wik)

> There are no real hills near Edward River. Only trees or birds may be *putpun* 'above', or *kan (-kan)* 'on top'. (K-Th)

> No [situations where it is relevant] - even the houses are prefab! (ANIN)

DISTANCE *D3* *The distance between A and B is (some number of local units for measuring distance).*

This question was rated as very difficult (see Table 4.3). A query in the comments column asked respondents to indicate the source of difficulty. All ticked either choice (a), i.e. that there were no local units, so the statement was inapplicable, or choice (b), i.e. that the abstract term "distance" was difficult to translate; or both choice (a) and choice (b). No other comments were made.

WEIGHT *W3* *The object weighs (some number of local units).*

> The only way a thing is measured for weight is in relation to whether it is 'heavy - for that type of fish' (or) 'light - for that bag with fish in it', etc. (Ma)

> [The] only comparison [is] 'this one is heavy; that one very heavy' etc. (WHC)

AREA *A3* *The area of the (camp; garden; sports ground) is (local units).*

> No local units - either big or small or 'like this', and size pointed out by comparison with something else. (Gu)

VOLUME *V3* *The volume of the water is equal to (some number of local units for measuring the volume of water).*

> No word for volume, no local units. (Gg-Y)

> Uncultural (K-Th)

There were no other comments on this question. It appears that any discussion of the measurement of volume in relation to life in a tribal Aboriginal community can be summed up in that one word "uncultural"! Of all the topics covered, Volume evoked the most uniformly negative response (see Table 10).

TYPE 4 QUESTIONS

These were of the form:

This __________ is __________ (standard measure) long.

Table 4 summarises the answers to these questions.

Table 4

Weighted mean difficulty ratings
for Type 4 questions

Topic	WMD
Length	6.54
Speed	5.89
Weight	5.94
Volume	5.25
Money	3.44

Respondents' Replies to Type 4 Standard Questions

LENGTH L4 *The (rope; spear) is *(2 metres) long.*

**OR ANY OTHER LENGTH INVOLVING A STANDARD UNIT, e.g. 3ft.*

(Note: In the comments column, respondents were invited to comment on the extent to which standard units of length are used and understood in the community.)

> Not understood and not used by most of the community. Some men from cattle stations have learned some of the terms for units from experience fencing (yards) nails (inches) holes (feet), but I suspect they are not fully understood. (Walm)

> Concept of measured length understood as a European tool - except for those who have been to school, use would be minimal. Materials (bought in bulk and sold at the same price) are bought in "worth", e.g. $1 = 1 skirt, $1.50 = a small dress, etc. rather than length. (Nya)

> Men in builder's team usually measure required length of timber directly into allotted space, or use tape like a stick for measuring without reference to figures (as they are middle-aged men). Most younger men probably use terms such as 15', 20' if necessary re boats of specific length and guess roughly, but for practical purposes they use hands to indicate height, etc. (Anin)

[Length] is understood and used by those people who have had to understand and use it in their work. (Dja)

Most people have had some schooling and are fairly familiar with English inches, feet, yards, miles, etc. (Ar)

SPEED S4 *The car was going at 60 miles an hour.*

A few use Walmatjari structure, for 'the car was running' then insert '60 miles an hour' in English. Most don't have the concept of how X miles per hour feels. Not commonly used in speech. (Walm)

[They would use] the transliterated word -

tjikitjingka 'at 60'
'sixty-at'

(Pitj)

Doubt whether it is used, even in English. We have 1 or 2 very short, gravel roads, and speeds would be 'fast', 'very fast', and 'hot rod'! (Nung)

WEIGHT W4 *The object weighs * (5 kilograms)*

** OR ANY OTHER WEIGHT INVOLVING A STANDARD UNIT, e.g. 8 ozs.*

(Note: In the comments column respondents were asked to comment on how relevant it would seem to the people to be able to measure the weight of objects.)

Not relevant. In the local store where potatoes and onions are traditionally weighed and sold by the pound, the Aboriginal shop assistant fills a certain sized bag as his measure. (Walm)

Not at all relevant. (Ngaa)

The only thing is for weighing their babies. But the significance is not in the amount it weighs, but if the chart shows it is getting heavier (and therefore mother is praised and not scolded by the sister!!) (Gu)

Relevant for the younger ones perhaps in weight of sugar, flour, etc. Mostly it's just the 'big bag' or 'little bag'. (Gg-Y)

Not used. The relative terms 'heavy/light' are probably sufficient. (Nung)

VOLUME V4 *This (petrol can; jug; soft drink can) holds (5 gallons; 2 litres) OR ANY OTHER STANDARD UNIT FOR MEASURING VOLUME.*

(Note: In the comments column the respondents were asked to indicate in what situations, outside of school and work, the people need to measure volume.)

[Used] for petrol for the cars - tho' full and empty or plenty and none cover the needs here. You could say that "this car has 5 gallons in it", but it wouldn't mean anything! (Gu)

[Relevant for] buying petrol for outboard motors. Actually they don't need to measure volume even then. They bring the container and it is filled by the shop keeper. (Gg-Y)

[Relevant for] petrol, fruit juice, etc. [but there are] normally only two sizes, therefore 'small' and 'big' are adequate terms. (Anin)

MONEY *M4 The cost of the article is 20 cents.*

The responses to this question illustrate the way in which English terms, where relevant, are borrowed and become part of the vernacular, with the appropriate suffixes.

This "item" 20-cents-*mirr*. (-*mirr* = 'possessing') (Dja)

nukapa ja lolly kimin 20 cents
'This lolly is 20 cents' (Ma)

You buy it for 20 cents. (Underlined is in English) (Anin)

20c = *tuupup* 'two bob' (Warl)

Literally 'For this book you give 20 cents'. (Wik)

The high difficulty ratings and the respondents' comments indicate that, with few exceptions, standard units of measure are infrequently used and poorly understood in most tribal Aboriginal communities. Even now, standard measures are only required for European-initiated activities. It seems unlikely that their use will increase, except as the Aboriginal person sees a need for standard units in everyday life.

The attitude to standard units of measure, as revealed in the responses quoted, clearly illustrates the dictum that necessity is a good teacher. Since nearly everybody handles and talks about money, terms have been adopted and adapted to meet the need. Terminology for money was one "gap in the inventory of cultural items" (cf. ch.1) that was easily filled by Aborigines as the necessity arose. However, where "big" and "little", and "this long" (with a concrete example) are sufficient to meet a people's needs, why should they change their ways?

An example of the universal reluctance to change established habits is seen in the reluctance of some white Australians to adopt metric measures, and their corresponding slowness to learn them. The present writer's experience may be used as an example. In spite of a positive attitude towards metric conversion, it has taken many years to change ingrained habits of thinking, and the process is far from complete. Even now, there are only a few areas of metric measure where

I do not usually have to think twice and mentally convert to the old measurement. I came to grips with kilometres only when I left the Northern Territory and went to Melbourne. It was necessary then in order to get a Victorian driver's licence, and besides, the concept of kilometres was constantly reinforced in the new environment. Since the road signs were all in kilometres, and the speedometer only showed miles, there was an urgent need to learn the conversion if I wished to read the latest maps and also to avoid the risk of being booked for speeding. These things had not been important while I was living on an Aboriginal reserve almost 200 miles from the nearest town.

TYPE 5 QUESTIONS

These were of the form:

> *The two __________ are the same (length, height), etc.*

Table 5 summarises the answers to these questions.

Table 5

Weighted mean difficulty ratings for Type 5 questions

Topic	WMD
Length	2.63
Height	1.88
Distance	3.65
Speed	3.13
Time	4.88
Weight	3.94
Area	4.29
Volume	4.59

Respondents' Replies to Type 5 Standard Questions

LENGTH *L5 The two (spears; ropes) are the same length.*

Literally: 'Those two spears have their heads together'. (Wik)

They would say 'the same', which does not necessarily imply length, just general sameness. (Gg-Y)

They use 'same' in conjunction with the word for 'long'. (Nya)

To say 'same length' one would have to say something like 'This stick is long, and that stick is long. They are the same'. (Ma)

In addition to the basic standard question, there was with L5 a supplementary question in the comments column asking whether the people (e.g. teaching assistants) ever use a localisation of the English term 'level' when measuring length, so that they would say "This one and this one are level". Ten respondents replied that such a term was used, for example *lipulu* in Warlpiri and *lebel seim* in Roper Creole. The respondent for Walmatjari noted that this usage extends to other features of sameness, for example, people born at the same time. Similarly, the linguist for the Gurindji language stated that the stimulus sentence would be translated with a Gurindji phrase meaning 'these two are level'. He was using two pencils of equal length when the phrase was elicited, but said he had also heard the same word used in reference to two trees and in reference to two children who were the same age.

HEIGHT *H5 The two (men; trees; fence-posts) are the same height.*

The literal translation of H5 is 'They are both tall, and they are the same'. (Ar)

Tubala lebel (Height is understood). (RoCr)

Examples: 'These two men are short/tall; they're the same', or 'these two men are the same' in context of discussion re height. (Anin)

DISTANCE *D5 The distance between A and B is the same as the distance between C and D.*

'A is distant from B, like C is distant from D.' (Ar)

Can say 'It's a long way; like between C and D'. (Gg-Y)

Supplementary questions in the comments column asked if this type of comparison would be made in the daily life of the community and whether it would be in terms of ground distance covered or time taken to travel the distance. Ten respondents said that such comparisons would be made, and seven said they would not, or at least not often. Nine said that time taken would be the aspect in focus, while only three said that the primary focus would be on ground distance covered. Another four said both time and distance would be considered.

SPEED *S5 A runs at the same speed as B.*

Can only say 'A goes fast like B', or 'A goes slow like B', or 'A runs the same like B - with equal power'. (Gu)

TIME *T5 Yesterday I walked from A to B; today I walked from C to D, and on both occasions I took the same amount of time.*

The questions relating to time had the highest difficulty rating of the Type 5 questions. A large number of comments are quoted to show the strong reaction against even trying to make such a comparison of lengths of time.

> It's irrelevant to talk about how long it takes to go somewhere. It's abnormal to compare times taken to do two things. (Walm)

> Time isn't compared - not regarded as something that is measured in degrees. (Gu)

> It would be necessary to restructure as follows: 'Yesterday I left A at time X and arrived at B at time Y. Today I left C at time X and arrived at D just like that (previously referred to)'. (Ngaa)

> . . . I don't think 'from - to - ' is a natural, common expression . . . probably because the hearer knows the starting point. (ANIN)

> "Counting" time is not cultural. (K-Th)

> To explain it in terms of distance comes more naturally, e.g. 'both are the same, both are close/far'. Can add - 'I got there quickly' or 'took a long time'. (Wik)

> They wouldn't think of measuring the time taken. (Iw)

> Time would be directly proportional to distance, and therefore irrelevant. (Pitj)

> The involvement of time in the situation is pointless. (Dja)

WEIGHT W5 *The two (stones; children; bags of bush tucker) are the same weight.*

> 'They are the same - both are heavy (or light).' (Ar)

> 'One is not heavy: they're the same.' (K-Th)

> 'They are the same in heaviness.' (Mur)

VOLUME V5 *This bucket and this tin both hold the same amount of water.*

> 'One can pour the same amount of water into this bucket and this tin.' (Ngaa)

> 'I can pour a lot of water into A, like in B.' (Anin)

> 'This bucketful is the same as this tin if both are full of water.' (K-Th)

> [We can only say this] by using the word *seim* or *lebel*, but not expressing volume explicitly. (RoCr)

TYPE 6 QUESTIONS

These were of the form:

> *The length of A plus the length of B is equal to the length of C.*

Table 6 summarises the answers to these questions.

Table 6

Weighted mean difficulty ratings
for Type 6 questions

Topic	WMD
Length	5.50
Time	6.00
Weight	4.65
Area	5.24
Money	4.94

Respondents' Replies to Type 6 Standard Questions

LENGTH L6 *The length of A plus the length of B is equal to the length of C.*

This question had high difficulty ratings. In response to a question about the source of the difficulty, fourteen respondents replied that the practice of combining lengths is not common in the culture.

TIME T6 *To do activity A and then immediately do activity B, takes the same time all together as doing activity C.*

> The informant gave considerable restructuring of 'To build a shelter, and then cook the damper, takes the same time altogether as cooking a kangaroo'. [The informant said] 'I put the kangaroo to cook, then I built a shelter, cooked a damper, and then, as the kangaroo was cooked, I took it out of the fire'. (Ngaa)

> [This statement] seems almost impossible!! [It's] easier to think of one long activity as really long, and the other two as shorter bursts. (Wik)

> May possibly refer to equal starting and finishing points for activities; but not abstract duration. (Rem)

> This sort of thing is very foreign to them. (Gg-Y)

Time is not usually measured, let alone compared. (Dja)

[This statement] is difficult because it sounds silly! We could say it in a long sentence! (Anin)

[This statement is difficult] because people are culturally event-orientated, not time-orientated.

WEIGHT **W6** *A and B together are as heavy as C.*

[Such a statement is relevant] only in context, for example carrying weights on shoulders when you want them to balance evenly. (Anin)

'A and B are light separately; together they are the same as C'. (K-Th)

AREA **A6** *The area of A and the area of B together is equal to the area of C.*

'Areas A and B are small; they're together the same as area C.' (K-Th)

[The meaning of this statement] could be conveyed easily, but I cannot think of any situation where it would be applied traditionally. Areas would be allocated according to need - comparisons of this nature are European in concept. (Nya)

MONEY **M6** *The cost of A plus the cost of B is equal to the cost of C.*

'A joined to B will mean C will have to be given.' (Pitj)

'A cool drink and a chocolate is like a tin of meat.' (Ngaa)

'The price of A and B together is the same as the price of C (alone).' (K-Th)

TYPE 7 QUESTIONS

These were of the form:

A is longer than B.

Table 7 summarises the answers to these questions.

Table 7

Weighted mean difficulty ratings
for Type 7 questions.

Topic	WMD
Length	1.95
Height	2.24
Distance	4.83
Speed	2.75
Time	4.44
Weight	2.82
Area	3.88
Volume (less)	4.56
Money (cheaper)	3.00

As a teacher in an Aboriginal school I was told (or at least gained the impression) that comparatives and superlatives were difficult for Aborigines because their languages do not have single terms which are equivalent to words such as longer and longest in English. The answers to Type 7 and Type 8 questions show that it is not the concept that is difficult, but only the English terminology. The way of expressing the concept is different in most Aboriginal languages from the way it is expressed in English, but the same meaning is adequately conveyed. However, such comparisons in relation to distance, time, area and volume are more difficult because they are not usually required.

Respondents' Replies to Type 7 Standard Questions

LENGTH L7 *A is longer than B.*

Asked in the comments column what the literal translation into the vernacular would be, eleven respondents marked choice (a) 'A is long, B is short'; four ticked choice (b) 'B is long, but A is very long', and two marked (c) 'the same as for English, i.e. there is a concise way of expressing the comparative'. In some cases either (a) or (b) would be used, depending on the absolute size and the degree of difference in sizes.

HEIGHT H7 *A is higher up than B.*

(For example, one bird's nest is higher up the tree than another.)

Most respondents either said that the literal translations would read (a) 'B is high, but A is very high' (8 respondents), or (b) 'A is high; B is low' (9 respondents). Other alternatives were:

> 'One is close (to the speaker); the other is further (away from the speaker) up.' (Walm)

'This one is high up to/for that one.' (Warl)

'One a-bit-near-the-bottom and other above.' (Dja)

DISTANCE D7 *The distance between A and B is greater than the distance between C and D.*

It would not be natural to specify A and B and C and D. (Ngaa)

Sayable, but not usual to make such comparisons. Must use 'A is far from B, and C is quite close to D'. (Gu)

TIME T7 *It took a longer time to walk from A to B today than it did yesterday.*

Most of the responses to this question indicated that the Aboriginal person would be more likely to talk about going slowly or quickly rather than a longer or shorter time. One linguist said that she did not know any reason why anyone would want to say that, and another in reply simply asked "Why did it take a longer time?" In the same vein, a third respondent said that there would presumably be a reason and all details would have to be spelled out.

'I went to B yesterday and again today. Yesterday I arrived at midday, today (I was tired, etc) I arrived in the afternoon.' (Anin)

'Yesterday when I went to the landing it seemed short, but just now, it seemed like a long distance to me.' (Distance comes more naturally, but you can add 'I seemed to get there quickly' etc.) (Wik)

'Yesterday I went to B and today I went to B, but yesterday I got there quite quickly, and today I took a long time to get there.' (Gu)

We can say 'she runs faster', but not the comparison 'than B' (Tiwi)

WEIGHT W7 *A is heavier than B.*

As for the other topics, the comparison is usually between the extremes 'heavy' versus 'light' or 'heavy/very heavy' or simply 'big' and 'small'.

AREA A7 *The area of this (garden; camp; football field) is bigger than the area of that one.*

Replies indicate that one area in relation to another could be described as 'bigger', 'smaller', 'wider', or 'longer', but such comparisons are not often made.

VOLUME V7 *This tin holds less water than this bucket.*

'The water from this bucket will fill and overflow this tin.' (Ngaa)

'This bucket has much water - the tin has not much water.' (K-Th)

We would say the tin is smaller. (Gg-Y)

They refer to the size of the container, not to capacity. (Iw)

MONEY M7 *A is cheaper than B.*

'A is less than B' (price understood). (Ar)

'B is dear one; A is cheap one.' (Iw)

'A is quite a small amount of money, not like B which costs a lot of money.' (Gu)

B price pork-kak, A mantam
B is big-priced, A small'. (K-Th)

People use *Tiya* 'dear' for expensive. (Warl)

TYPE 8 QUESTIONS

These were of the form:

> *A, B and C are all short, but C is the shortest of all.*

Table 8 summarises the answers to these questions.

Table 8

Weighted mean difficulty ratings
for Type 8 questions

Topic	WMD
Length	2.32
Height	2.31
Distance	1.76
Speed	3.18
Time	5.07
Weight	2.71

Note again that the Time question is rated as by far the most difficult. Although the languages easily describe the superlative degree of comparison, it is not common to compare lengths of time in the abstract way that the question implies. Time taken depends on so many other factors; for example, number of workers, availability of materials and the complexity and immensity of the task in question.

Respondents' Replies to Type 8 Standard Questions

LENGTH *L8 A, B, and C are all short, but C is the shortest of all.*

Almost half the translations given followed the formula 'A, B, and C are short; C is very/truly/more/a bit short (± in comparison to/beside the other two)'. Four followed the very similar formula 'A and B are short; C is really short'. Others compared 'short/shorter/very short' (RoCr), 'long/short/little bit long' (ANIN), 'long/short/really tiny' (Wik), 'short, more short and more short' (WHC), and so on. Some examples are given.

'These three pencils are short; one is a little bit long, another is a bit short, but the other is really tiny.' (Wik)

'These are short but this is short (intensified).' (Nung)

HEIGHT *H8 Persons A, B and C are all tall, but C is the tallest of all.*

'They're all tall. This one (tallest) is tall; this one (next highest) follows him, and this one (shortest) follows them.' (Tiwi)

Dis tubala longwan, bat dijan iya im brabli longwan.
'These are long, but this here is very long.' (RoCr)

'These three men are tall, but this one, Terry, his head shoots out above the other two, he's really long in relation to those two (indirect object pronoun). Those two stand a bit short alongside him.' (Wik)

'Three men size long, but one two-from a-bit size long.' (Dja)

'A and B are tall; C is very tall' or 'A and B are short; C is tall (long).' (K-Th)

As the Aboriginal languages do not usually have separate terms for length and height, although the different concepts are understood, it may reasonably be expected that Aboriginal people speaking English as a second language might tend to use the term "long" when talking about a tall person. Asked whether this were so, eleven respondents said Yes, it was, and eight said No, it was not.

__DISTANCE__ __*D8*__ *Points A, B and C are all far away but point A is the most distant of all.*

(Note that the question refers to three points which are __all__ far distant.)

'A, B, and C are far away. A is far away west, B and C are this side of it (toward me).' (Walm)

'B and C are distant, A is very distant.' (K-Th)

They are all just 'long way'. (Iw)

__TIME__ __*T8*__ *Of three activities, A, B, and C, activity C will take the longest time.*

'A, B and C (take) long work/time, but C is very long work.' (Gu)

Asked in the comments column whether there were any traditional activities for which this sort of statement would seem to the people to be relevant, eight respondents explicitly stated that they could not think of any. Some ignored the question, which suggests that they also considered the statement irrelevant; others gave suggestions, as follows.

I didn't discover [any relevant situation]. One activity was chosen as taking a very long time over two others, but the construction was that that activity (pictures) takes a very long time. (Walm)

[Could be relevant for] comparison of a few workers versus lots for a traditional ceremony like a house opening after a death (length of time in preparation, e.g. few relatives versus lots), or for cooking time of various animals in ground oven. (Wik)

[May be relevant for] making spears, boomerangs, or shelters. Don't really know how relevant it would be. Very little I think. (Gg-Y)

Where a traditional activity is regarded as long, it's because of its content or the work involved rather than actual time taken. (Iw)

Yes, [it is relevant for] hunting.
'Mary got oysters and took a little (while).'
'Jean got yams and took a little (while).'
'Jack went after a wallaby and took a very long time.'
The informant says people often compare whether people took a long time or short time to do something in relation to another person. This applies when two people are doing the same thing at the same time or the same thing at different times, but not when they are engaged in two different activities. (Ma)

SPEED *S8* *Runners A, B and C are all fast, but C is the fastest of all.*

WEIGHT *W8* *A, B and C are all heavy, but C is the heaviest of all.*

The contrast in these two statements was usually between fast/slow heavy/light, or else fast/very fast, heavy/very heavy.

'A, B, and C can go quickly, but C can go greatly quick.' (Pitj)

'A, B, and C all run fast, but C goes past them.' (Ngaa)

We would just say 'that one is the heavier one'. (Tiwi)

6.3 Order of Difficulty of Standard Question Types Requiring a Difficulty Rating

For the standard question types that required a difficulty rating, the averages of the weighted mean difficulty ratings were calculated, and the question types tabled in descending order of difficulty, as shown in Table 9.

Table 9

Order of difficulty of standard question types which required a difficulty rating.

Question Type	Question Content	Average Weighted Mean Difficulty
3	Local units	6.75
4	Standard units	5.41
6	A + B = C	5.27
5	A = B	3.62
7	Comparative	3.39
8	Superlative	2.89

The six question types seemed to fall into two groups. At one end were those questions which required the use of units of measure and involved addition or combining of units of measure. These were generally rated as difficult, with questions involving the use of local units of measure being rated as the most difficult of all. At the other end were those questions that did not require either the use of units of measure or combining of measurements, but which involved judgements based directly on visual observation. These were rated as generally fairly easy, with questions involving the use of the superlative being rated the easiest of all.

The average weighted mean difficulty of Type 4 questions is biased by the inclusion of the Money question which had a much lower difficulty rating than Type 4 questions in other topics (WMD 3.44). Without the inclusion of the Money question, the average weighted mean difficulty of Type 4 questions would be 5.91.

6.4 Order of Difficulty of Topics Covered

For all the standard type questions in each topic the average weighted mean difficulty was calculated, and the topics were then arranged in apparent order of difficulty, as shown in Table 10.

Table 10

Order of difficulty of topics covered according to the average weighted mean difficulty of all standard questions for which a rating was required.

Topic	Average Weighted Mean Difficulty	Question Types Included in Topic
Volume	5.35	3, 4, 5, 7
Area	5.10	3, 5, 6, 7
Time	5.10	5, 6, 7, 8
Weight	4.43	3, 4, 5, 6, 7, 8
Distance	4.28	3, 5, 7, 8
Length	4.27	3, 4, 5, 6, 7, 8
Money	3.79	4, 6, 7
Speed	3.74	4, 5, 7, 8
Height	3.18	3, 5, 7, 8

Although it is probably safe to conclude that the topics of Volume, Area and Time, as shown in Table 10, were the most difficult topics on the questionnaire, it would not be safe to assume, for example, that the topic of Height was significantly easier than the topic of Length. Two factors would have biased the figures shown in Table 10.

1) How many standard questions were included in the topic. Length and Weight were the only topics that included all standard questions, and in other topics only three or four of the standard rating questions were included.

2) Which of the questions were included in the topic. For example, inclusion or omission of question type 3, which had the highest average difficulty rating of all the question types, would affect the average difficulty rating for the topic. For this reason, Table 10 shows which of the standard questions requiring a rating were included in each topic.

CONCLUSION AND RECOMMENDATIONS

indigenous a. native, belonging naturally.

native a. derived from one's country or parents.

(Australian Pocket Oxford Dictionary)

CONCLUSION AND RECOMMENDATIONS

The conclusion drawn is that any applied number program which is written for English speaking white Australian children mainly living in urban situations is likely to be both inappropriate and inadequate for use with vernacular speaking Aboriginal children living in remote tribal communities because:

(a) many of the concepts presented will be foreign to the Aboriginal child and in conflict with his traditional world view,

(b) in many instances the way of expressing the concept in the child's first language will be quite different from the way in which it is expressed in English, thus causing confusion with vocabulary and terminology,

(c) in some cases, where the concept is totally foreign to the child's culture, there will be no concise way of explaining it in the child's own language. Thus the child will be required to learn new vocabulary and a new concept, both at the same time; and usually to do so in a second language,

(d) many of the concepts introduced will not be reinforced outside of the school because they are either not used in the Aboriginal community, or are in conflict with established custom,

(e) the concepts presented will assume prior knowledge and experiences that the Aboriginal child does not have, while ignoring the different set of knowledge and experiences that the Aboriginal child does have, and because,

(f) failing to take account of the Aboriginal child's different cultural environment, such a program will also fail to observe the fundamental principle that teaching must always begin with that which is known and proceed from the known to the unknown.

On the basis of this conclusion, the following recommendations are made. These recommendations are addressed specifically to the Department of Education in the Northern Territory, but are applicable to any department of education in Australia that is required to cater for Aboriginal children who live in a tribal situation and whose first language is not English.

Recommendations

1. That it be considered a matter of urgent necessity to initiate and implement a program of research aimed at developing mathematics curricula appropriate to the environment and needs of tribal Aboriginal children in Australia.

2. That in such a research program the greatest possible use should be made of the knowledge and experience of Aboriginal teachers, whether trained or untrained.

3. That maximum use should be made of the enthusiasm and expertise of teachers in the field, and that approved local research projects should be given official recognition and support.

4. That research and curriculum development should combine the knowledge and skills of persons competent in the fields of mathematics, education psychology, child development, linguistics, and anthropology, working in close co-operation with teachers in Aboriginal schools.

5. That, in establishing the aims and directions of such research, the Department of Education should consider the example of the *Indigenous Mathematics Project* currently being conducted by the Department of Education in Papua New Guinea.

> The Indigenous Mathematics Project has two broad, complementary aims.
>
> > First, to study and document the many traditional (or native) mathematics systems of Papua New Guinea.
> >
> > Second, to adapt the primary mathematics curriculum to the abilities and knowledge of entering pupils [and] to the demands placed on them for mathematics fluency in village life, post-primary employment and schooling.
>
> But more simply, the aim is to create a curriculum that belongs naturally to Papua New Guinea (Papua New Guinea Department of Education, 1977).

Similarly, the broad aims of a research program into mathematics education for Australian Aborigines could read:

> First, to study and document the many traditional (or native) uses of mathematics in Australian Aboriginal communities.

Second, to create a primary mathematics curriculum suited to the abilities and knowledge of Aboriginal pupils, and to the demands placed on them for mathematics fluency in the life of the community where they live, in employment, and at school.

In other words, the aim is to create a mathematics curriculum that belongs naturally to the Australian Aborigines.

APPENDIX A

DESCRIPTION OF MATHEMATICS IN ABORIGINAL SCHOOLS PROJECT

APPENDIX A

DESCRIPTION OF MATHEMATICS IN ABORIGINAL SCHOOLS PROJECT

During 1980-81 the Northern Territory Department of Education and the Curriculum Development Centre in Canberra are cooperating in a national project aimed at gathering and disseminating information about the teaching and learning of mathematics in Aboriginal schools, with a view to finding ways to improve performance. The Project Officer is Ms Pam Harris, author of this present study, and former Education Adviser in Mathematics for Aboriginal schools in the Northern Territory.

Ms Harris will be based in the Evaluation and Research Section of the N.T. Department of Education, but expects to do a lot of travel to other states as well as within the Northern Territory, visiting Aboriginal schools and talking with other people who are involved with mathematics education for Aborigines. The purpose of these visits will be a reciprocal exchange of information on a variety of topics related to teaching mathematics in Aboriginal schools. The plan is to collate the information thus collected from all over Australia, and make it available, possibly in the form of a teacher's handbook, to such groups as teachers of Aboriginal children, teachers in training, curriculum officers and advisers, and educational research groups.

Proposed topics for inclusion in the study are:

1) The role of mathematics in the lives of Aboriginal children in the context of the particular physical, cultural, and linguistic environment in an Aboriginal community.

2) The influence that the Aboriginal child's environment may have on the school learning of mathematics.

3) Points to consider when deciding whether to use English or the child's own language as the medium of instruction at different stages of the mathematics program, particularly in the context of a bilingual education program.

4) Current practices in teaching mathematics in Aboriginal schools in different parts of Australia (curricula, methods, difficulties...)

5) Suggestions for -

   (a) classroom initiatives to improve the quality of mathematics teaching and learning in Aboriginal schools, and

   (b) research needed to allow for more informed decisions about curricula and methods.

An Information Exchange has been established in connection with the project, and people interested in sharing ideas about mathematics in Aboriginal schools and communities can ask to join the exchange. All correspondence should be addressed to -

Ms Pam Harris,
Project Officer,
Mathematics in Aboriginal Schools,
P.M.B. 25,
WINNELLIE, N.T. 5789

APPENDIX B

EXAMPLES OF LANGUAGE ENGINEERING TO EXPAND MATHEMATICAL VOCABULARY

WARLPIRI CALENDAR

Pipuwarri Karlami karla kanunju ngunju-ngunjuku.

JANTIYI		3	10	17	24
MANTIYI		4	11	18	25
JUUJIYI		5	12	19	26
WINIJIYI		6	13	20	27
JAYIJIYI		7	14	21	28
PURATIYI	1	8	15	22	29
JARRITIYI	2	9	16	23	

The February page of the 1980 *Warlpiri Kalinta* produced at Yuendumu, Northern Territory. It illustrates the use of transliterated terms in a community where people are rapidly becoming literate in their own language.

NAMES FOR MONTHS

Names for months of the year as they appear in the 1979 *Warlpiri Kalinta* printed at Yuendumu in the Northern Territory, and in a modern Indonesian calendar.

WARLPIRI	BAHASA INDONESIA
Januwarri	Januari
Pipuwarri	Pebruari
Maaji	Maret
Yapirili	April
Mayi	Mei
Jurnu	Juni
Julayi	Juli
Wukuju	Agustus
Jipitimpa	September
Wukutupa	Oktober
Nupampa	Nopember
Tijampa	Desember

NUMBER NAMES USED IN THE BILINGUAL PROGRAM AT YUENDUMU

The number names shown are as reported by Jeannie Nungarrayi Egan, an experienced Warlpiri teacher from Yuendumu, during a conversation with the writer 28 February, 1980.

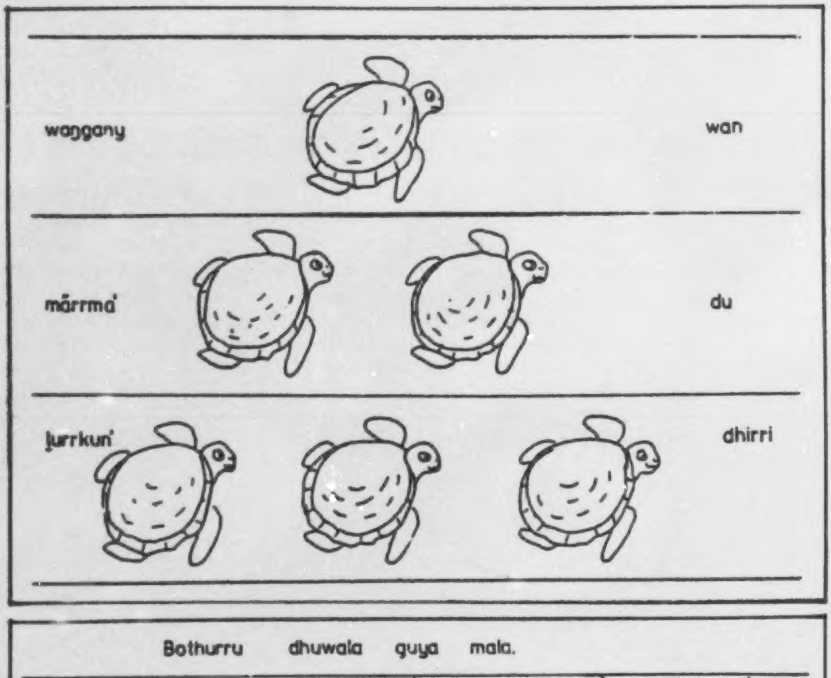
Symbol	Warlpiri Number Name	Origin
1	jinta	Traditional Warlpiri language
2	jirrama	" " "
3	marnkurrpa	" " "
4	mirdi	" " " (This word had fallen into disuse, but some old people remembered it, and its use is being revived in the school.)
5	rdaka	Traditional word - also means 'hand'.
6	jika	Borrowed from English and written as it is spoken by Warlpiri people, particularly in the context of card games.
7	wirlki	Descriptive of the shape of the numeral. *Wirlki* is the name of a killer boomerang which is shaped like a seven.
8	milpa	Descriptive of the shape of the numeral. *Milpa* means 'eye'.
9	narntirnki	Descriptive of the shape of the numeral. *Narntirnki* describes something which is bent, such as the bough of a tree or a curving road.
10	karlarla	Traditional Warlpiri word.

NUMBER NAMES USED IN THE BILINGUAL PROGRAM AT YIRRKALA

TRADITIONAL GUMATJ LANGUAGE	TRANSLITERATION	ENGLISH
Waŋgany	Wan	One
Märrma'	Du	Two
Ḻurrkun'	Dhirri	Three
Ḏämbumiriw	Bo	Four
Waŋgany Rulu	Bayip	Five
	Djik	Six
	Djapin	Seven
	Ayit	Eight
	Ŋayin	Nine
	Diyin	Ten

At the time that they start school, the Gumatj children know and use all of the traditional Gumatj number terms and some of the transliterated terms. During the time that they are learning to read and write their own language at school, they freely use either set of terms, and learn to recognise both in writing (as shown in the following examples from a Gumatj number book). The traditional Gumatj words would usually be used in general conversation, and the transliterated terms would more often be used in specifically mathematical contexts such as counting and manipulating numbers.

Later, in the context of learning English as a second language, they learn the English spelling and pronunciation of the number words. Adults in the community tend to use whichever term suits the social context, i.e. English number names when speaking English to a white person, the transliterated terms when speaking or writing Gumatj in a modern context, and the traditional terms when using Gumatj in a traditional context such as discussing a hunting trip with an older person. Both the traditional and transliterated terms are freely used in the community's Gumatj language magazine.


waŋgany
wan
märrma'
du
ŋurrkun'
dhirri
wan
djik
du
djapin
dhirri
ayit
bo
ŋayin
bayip
diyin

Bothurru dhuwala guya mala.

Gumatj Numbers

Sample pages from the book *Gumatj Numbers*, which was produced at Yirrkala, in North Eastern Arnhem Land, for use in the school's bilingual mathematics program.

DEVELOPMENT OF MATHEMATICAL TERMS BY ABORIGINAL TEACHERS AT GOULBURN ISLAND

In July 1978, a group of six Aboriginal teachers at Goulburn Island School wrote to inform the Mathematics Adviser in Darwin that they had recommended to the school staff that Maung words and spelling should be used until Grade 4 for number names, days of the week, months of the year, geometrical shapes, and colours. Attached were lists of the terms which they planned to trial and refine as necessary. Some of these are shown below. They had been written down during discussions initiated by the Aboriginal teachers for that purpose. In looking at them English speaking readers should remember that the same letters and combinations of letters have different sound values when used in writing English and when used to write Maung, the language spoken at Goulburn Island.

SHAPES

English	Maung
circle	jekul
diamond	jaymen
square	kuwe
rectangle	rektengkul

COLOURS

red	ret
blue	parlu
purple	pepul
green	kurin
orange	orij
brown	purawn
white	wayt
pink	pingk
yellow	yalow
black	* purlek

NUMBERS

Symbol	English	Maung
1	one	wan
2	two	tu
3	three	jurri
4	four	po

5	five	payp
6	six	jik
7	seven	jepen
8	eight	eyt
9	nine	nayn
10	ten	ten
11	eleven	lepen
12	twelve	tuwelp
13	thirteen	* jertin
14	fourteen	portin
15	fifteen	pipteen
16	sixteen	jiktin
17	seventeen	jepentin
18	eighteen	eytin
19	nineteen	nayntin
20	twenty	tuwenti

Note: The spelling of the two words marked with an asterisk (*) is shown as it was adjusted later when the terms listed in the letter were discussed. It is likely that further minor changes have been made since then, but these lists are presented merely to indicate the usage which the Aboriginal teachers favoured, and which they listed as Maung, regardless of the fact that they have been borrowed from English.

APPENDIX C

QUESTIONNAIRE AND ACCOMPANYING INSTRUCTIONS

AUSTRALIAN ABORIGINES MATHEMATICS STUDY

INSTRUCTIONS FOR COMPLETING QUESTIONNAIRE

Look at the following three questions which are reprinted from the first page of the questionnaire. You will see that each question has four parts; the code, the question, the answer, and space for you to make further comment on that question.

Code	Question	Answer	For Further Comment
L2	Are there any local units for measuring length which are in general use, for example, hand-spans, spear-lengths, or specific lengths of rope?	Yes/No	If yes, then state briefly what they are and under what circumstances they are used.
L3	The length of the (piece of ground; rope; cloth) is (a number of local units of measure).	1 2 3 4 5 6 7	If you rated this statement as being difficult, did you do so because (a) there are no local units, so it is inapplicable? (b) the abstract term 'length' is difficult to translate? (c) of some other reason? (Please state.)
L3.1	The (piece of ground) is equal to (a number of local units for measuring length).	1 2 3 4 5 6 7	If the difficulty rating for L3.1 is different from the rating for L3 (above), please state the reason.

1. CODING

1.1 Standard Questions

The symbol for standard questions consists of the initial letter of the topic and a number. For example, L2 (above) is the second question about Length. Where there are supplementary questions, the code number has been decimalised. Thus L3.1 (above) is supplementary to L3 because it presents the same question in a different sentence structure. The coding has been standardised, so that questions L1, H1, D1, etc. all have the same format. This standard numbering of standard question types makes it easy for you to go back and see what answer you have given to the same type of question under previous topics. You will find that you answer the questions much more quickly and easily as you progress through the topics.

The topics covered in the study, together with the code letters used, are listed below in the order in which they appear in the questionnaire.

1. Length (L)
2. Height (H)
3. Distance (D)
4. Time (T)
5. Speed (S)
6. Weight (W)
7. Area (A)
8. Volume (V)
9. Money (M)

1.2 Miscellaneous Questions

In some topics there are questions which do not fit the standard format, and in these the capital letter M (for Miscellaneous) is inserted in the code between the topic initial and the number. Thus the code TM2 stands for the second miscellaneous question in the Time section.

2. QUESTIONS

2.1 Content Words

In considering each question within the context of the Aboriginal language and environment, you may substitute different content words to make the statement relevant to the vernacular speaker's situation. In some questions I have given a number of suggestions in brackets for words and situations that might be appropriate. For example, question L3 on the first page. When thinking about the question or discussing the translation with a language helper, you may follow one of my suggestions and talk about the length of a piece of ground, a rope, or a cloth; or you may substitute other content words more relevant to the community in which the vernacular is spoken. It does not matter.

The same applies to the algebraic terms, A, B, and C, where they are used (e.g. in L6), and to phrases like "person A", "event A", "location 1", "the article", "the object", and any other non-specific content words. For "event A" in question TM9, you might think of a basketball match, a corroboree, an initiation ceremony, or any other relevant event. For "location 1" you might talk about the camp, the shop, Papunya, Milingimbi, the bush, the school oval, or any other relevant location. It will vary from place to place.

FOR CONTENT WORDS, SUBSTITUTE WHAT IS RELEVANT TO THE VERNACULAR SPEAKERS.

There is no need to indicate what substitutions you used, unless you consider it important in relation to your answer.

2.2 Sentence Structure

To make sure that all respondents to the questionnaire give a difficulty rating for the same basic sentence, it is important not to alter the structure of the English sentence given. Therefore, when considering how to make the questions more relevant to the situation, DO NOT CHANGE THE BASIC STRUCTURE OF THE ENGLISH SENTENCE FOR WHICH YOU ARE GIVING A DIFFICULTY RATING.

(It is understood, of course, that the sentence structure will usually be different in the vernacular translation.)

3. ANSWERS

ANSWER ALL QUESTIONS BY PUTTING A CIRCLE AROUND YOUR RESPONSE.

3.1 Yes/No Questions

Most of the Yes/No questions are either about the availability of terms in the vernacular, or about the availability of local units of measure. If the answer for the language in which you work is yes, put a circle around "Yes" (e.g. Yes/No); if your answer is no, put a circle around "No" (e.g. Yes/No).

3.2 Difficulty Rating Questions

In these questions, you are asked to assess the degree of difficulty of expressing in the vernacular the sentence given in English. A rating of 1 means that it is quite easy to express the meaning in a relatively short, simple vernacular sentence which clearly carries the same meaning as the English sentence. At the other end of the scale, a rating of 7 indicates that it is very difficult, almost impossible, to clearly express in the vernacular the meaning of the English sentence given.

GIVE A RATING RANGING FROM 1 FOR VERY EASY SENTENCES TO 7 FOR SENTENCES THAT ARE ALMOST IMPOSSIBLE TO TRANSLATE.

4. COMMENTS

The last column, headed "For Further Comment", is there for your convenience. You can ignore it, or make the most of it. The additional questions and suggestions for comment which I have provided are the types of things I would say to you if I could talk to you while you were filling in the questionnaire. They are a guide only. Please do not feel restricted by them, but freely make whatever comments come to mind. I have simply tried to save you time by anticipating what the comments, problems, and possible translations might be. Instead of having to write your comment in full, you can simply circle (a), (b), (c), or (d) if one of the alternatives given applies in your situation, or circle "Yes" or "No" where that is the choice.

In a few places (e.g. L3) I have begun a question "If you rated this statement as being difficult...". This applies to questions rated 5, 6, or 7.

If the space left for other written comments is not adequate, use the space under the question, or put your comment in the section (coded 9) for ANY OTHER COMMENTS at the end of each topic. If putting comments on a different page, show the code of the question to which the comment refers.

5. SUMMARY OF INSTRUCTIONS

1. Use the code numbers to compare your answers to questions of the same type in different topics.
2. For content words, substitute what is relevant to the vernacular speakers.
3. Do not change the basic structure of the English sentence for which you are giving a difficulty rating.
4. Answer all questions by putting a circle around your response.
5. Give a rating ranging from 1 for very easy sentences to 7 for very difficult sentences.

6. Use the Comments column in whatever way is convenient to you.
7. If possible, return the questionnaire within two weeks of receiving it.

Thank you for your interest. It is appreciated.

N.B. You will find it easier to give ratings if you skim quickly through all questions on a particular topic before beginning to answer them.

Keep these instructions beside you as you fill in the questionnaire.

QUESTIONNAIRE

MONASH UNIVERSITY - FACULTY OF EDUCATION

AUSTRALIAN ABORIGINES MATHEMATICS STUDY

LANGUAGE : Name of Language ______________________________

Language Group ______________________________

Language Sub-Group ______________________________

Type of Language
(e.g. noun-classifying) ______________________________

Total Number of Speakers
of that Language (approx.) ______________________________

Name(s) of School(s) where a significant proportion of pupils speak that language as their mother tongue. ______________________________

____

Is the language used at all as a medium of instruction in a school? Yes/No

If it is, to what extent? ______________________________

____

____

LINGUIST : Name and postal address of person filling in questionnaire

____

____

Topic 1: LENGTH

			For Further Comment
L1	Does the language have an abstract term equivalent to the English word 'length' as in a sentence beginning "The length of the rope is ..." ?	Yes/No	If yes, then does the term, compared to the English word, have (a) much the same usage? (b) a much wider usage? (c) a more restricted usage? Is the term (a) introduced? (b) traditional?
L2	Are there any local units for measuring length which are in general use, for example, hand-spans, spear-lengths, or specific lengths of rope?	Yes/No	If yes, then state briefly what they are and under what circumstances they are used.
L3	The length of the (piece of ground; rope; cloth) is (a number of local units of measure).	1 2 3 4 5 6 7	If you rated this statement as being difficult, did you do so because (a) there are no local units, so it is inapplicable? (b) the abstract term 'length' is difficult to translate? (c) of some other reason? (Please state.)
L3.1	The (piece of ground) is equal to (a number of local units for measuring length).	1 2 3 4 5 6 7	If the difficulty rating for L3.1 is different from the rating for L3 (above), please state the reason.

__LENGTH__ (Page 2)

		For Further Comment
__L4__ The (rope; spear) is *(2 metres) long. *OR ANY OTHER LENGTH INVOLVING A __STANDARD UNIT__, e.g. 3 ft.	1 2 3 4 5 6 7	State to what extent you think the concept of a standard invariable unit for measuring length is __understood__ and __used__ in the community. You may need to distinguish between usage by people who have been to school and those who have not been to school.
__L5__ The two (spears; ropes) are the same length.	1 2 3 4 5 6 7	Would the vernacular translation carry the meaning (a) that the two are the same in some respect (length implied)? (b) that the equality in length is very approximate? (c) as for English, i.e. that the two are as near to exactly equa as is necessary for the present purpose? Do the people (e.g. teaching assistants) ever use a localisation of the English term '__level__' when measuring length, so that they would say "This one and this one are level"? Yes/No
__L6__ The length of A plus the length of B is equal to the length of C.	1 2 3 4 5 6 7	Would the same vernacular translation be used for '__is equal to__' as for '__is the same as__'? Yes/No If __L6__ is rated as difficult, is the source of difficulty (a) that the practice of combining lengths is not common in the culture? (b) that the linguistic structure is awkward? (c) some other reason? (Please state.)

LENGTH (Page 3)

			For Further Comment
L6.1	A and B placed end-to-end are as long as C.	1 2 3 4 5 6 7	If L6.1 is rated differently from L6 (previous page), please state the reason for the difference.
L7	A is longer than B	1 2 3 4 5 6 7	Would the vernacular translation read literally (a) "B is long, but A is very long"? (b) "A is long, Bis short"? (c) the same as for English, i.e. there is a concise way of expressing the comparative?
L8	A, B, and C are all short, but C is the shortest of all.	1 2 3 4 5 6 7	Would it be necessary to make the comparison in pairs, i.e. comparing A to B, B to C, and C to A? Yes/No What would the literal translation into the vernacular be?
L9	ANY OTHER COMMENTS REGARDING THE CONCEPT AND THE TEACHING OF LENGTH.		

Topic 2: HEIGHT

			For Further Comment
H1	Does the language have an abstract term equivalent to the English word 'height' as in the question "What height is it?"?	Yes/No	If yes, then does the term, compared to the English word, have (a) much the same usage? (b) a much wider usage? (c) a more restricted usage? If it is not the same as for English, in what way does the usage differ? For example, is the same term for height applied both to people, and to features of the landscape?
HM1	Are there different terms to distinguish between length (horizontal length) and height (vertical length)?	Yes/No	If yes, are the terms totally different, or formed from the same root word?
HM2	Are there different terms to distinguish between height and distance?	Yes/No	In relation to HM1 and HM2, do the terms used make quite clear what is in focus at the moment (length, height, or distance), or is it only inferred from the context?
H3	The (tree; pole) is (some number of local units) high.	1 2 3 4 5 6 7	In what situations would it seem relevant to the people to measure height?
H5	The two (men; trees; fence-posts) are the same height.	1 2 3 4 5 6 7	
H5.1	This man is as tall as that man.	1 2 3 4 5 6 7	If H5 and H5.1 have a different difficulty rating, what makes the difference?

HEIGHT (Page 2)

			For Further Comment
H7	A is higher up than B. (For example, one bird's nest is higher up the tree than another.)	1 2 3 4 5 6 7	Would the translation read, literally (a) "B is high, but A is very high"? (b) "A is high; B is low"? (c) as it reads in English? If none of the above applies, what would the literal translation be?
H7.1	A is taller than B. (Referring to people.)	1 2 3 4 5 6 7	In discussing the size of people, would there be a clear distinction made between someone who is big (tall) and someone who is big (fat)? Yes/No
H8	Persons A, B and C are all tall, but C is the tallest of all.	1 2 3 4 5 6 7	Do the people, when speaking English, tend to refer to a tall man as a 'long' man? Yes/No How would H8 be expressed in the vernacular?
H9	ANY OTHER COMMENTS REGARDING THE CONCEPT, AND THE TEACHING OF HEIGHT.		

Topic 3: DISTANCE

			For Further Comment
D1	Does the language have an abstract term equivalent to the English word 'distance' as in the sentence "The distance is shown on the signpost"?	Yes/No	If yes, is the term (a) introduced? (b) traditional?
D1.1	Are there separate terms to denote the following gradations of distance?		If there are other gradations of distance separately named, please list them.
	(a) here (close)	Yes/No	
	(b) there (mid-distant)	Yes/No	
	(c) there (far distant)	Yes/No	
D2	Are there any local units for measuring distance which are in general use in the community? N.B. THE QUESTION REFERS ONLY TO MEASURES OF DISTANCE, NOT TO TIME TAKEN IN TRAVEL.	Yes/No	If yes, then state briefly what they are and under what circumstances they are used.
D3	The distance between A and B is (some number of local units for measuring distance).	1 2 3 4 5 6 7	If D3 is rated as being difficult, is it because (a) there are no local units for measuring distance, so the statement is inapplicable? (b) the abstract term 'distance' is difficult to translate? (c) of some other reason? (Please state.)

DISTANCE (Page 2)

			For Further Comment
D5	The distance between A and B is the same as the distance between C and D.	1 2 3 4 5 6 7	Would this type of comparison be made in the daily life of the community? Yes/No In comparing distances, would the people usually refer to ground distance covered, or to time taken to travel the distance?
D7	The distance between A and B is greater than the distance between C and D.	1 2 3 4 5 6 7	
D7.1	Starting from the same place, point A is further away than point B.	1 2 3 4 5 6 7	Would the translation read literally (a) "B is near; A is not near."? (b) "A is not as near as B."? (c) "A is far away; B is near."? (d) the same as for English? If none of the above applies, what would the literal translation be?
D8	Points A, B and C are all far away but point A is the most distant of all. (Note that the question refers to three points which are all far distant.)	1 2 3 4 5 6 7	
D9	ANY OTHER COMMENTS REGARDING THE CONCEPT, AND THE TEACHING OF DISTANCE.		

Topic 4: TIME

			For Further Comment
T1	Does the language have an abstract term equivalent to the English word 'time' as in the sentence "It takes a long time."?	Yes/No	If yes, is the term (a) introduced? (b) traditional?
	Does the vernacular have terms to express the following time periods?		Where terms exist, state how the time period is measured (e.g. by recurrence of natural phenomena), and whether the measurement is thought to be traditional or introduced.
T1y	Two years	Yes/No	
T1m	Three months	Yes/No	
T1w	Two weeks	Yes/No	
T1d	Three days	Yes/No	
			Where a traditional measurement of a year exists, does the beginning and end of the traditional year coincide roughly with our Christmas season? Yes/No Would the people have difficulty with our notion that "a day and a night make one day"? Yes/No
T1s	Is the year divided into several seasons?	Yes/No	If yes, give a brief description (e.g. wet; hot and dry, etc.), and the time period covered by each season.
T1sl	Just as we say in English "I will go in July, is it possible to say in the vernacular "I will go in (name of season)"	Yes/No	Do the seasons have separate names which are not descriptive of the weather? Yes/No

TIME (Page 2)

For Further Comment

T2	Is there any countable unit of time smaller than a day? N.B. This question does not refer to points in time, such as sunrise, midday, afternoon, etc.	Yes/No	If yes, give details of the units.
TM1	It took a long time to build the house.	1 2 3 4 5 6 7	
TM2	It took a short time to walk there.	1 2 3 4 5 6 7	
TM3	At what time did you get there?	1 2 3 4 5 6 7	How often would the people refer to clock time when talking to each other outside of the school or work situation?
TM4	I got there at (point of time). HERE THE POINT OF TIME COULD BE MIDDAY, FOR EXAMPLE.	1 2 3 4 5 6 7	Over a day and a night, what points of time are enumerated? How are they distinguished (e.g. by the position of the sun, moon or stars; activities performed; the color of the sky)?
TM5	I went there two months ago.	1 2 3 4 5 6 7	Would the same term be used for a time two months removed from the present, whether it were in the past or the future? Yes/No

TIME (Page 3)

			For Further Comment
TM6	I will go there in two days' time.	1 2 3 4 5 6 7	How is two days' time expressed? Is the word for tomorrow reduplicated?
TM6.1	I came the day before yesterday.	1 2 3 4 5 6 7	
TM7	In the past I lived in that house.	1 2 3 4 5 6 7	
TM8	In future I will do as you say.	1 2 3 4 5 6 7	
TM9	Event A in location 1 and Event B in location 2 occurred simultaneously.	1 2 3 4 5 6 7	Does it make any difference how near geographically the two events occur? Yes/No Does it matter whether or not there is any relationship between the two events? Yes/No
TM9.1	I dropped the object and shouted at the same time.	1 2 3 4 5 6 7	Is there a verb tense that denotes simultaneity of action? Yes/No
T5	Yesterday I walked from A to B; today I walked from C to D, and on both occasions I took the same amount of time.	1 2 3 4 5 6 7	If T5 is rated as difficult, please explain why it is difficult.

TIME (Page 4)

			For Further Comment
T5.1	It takes the same amount of time to (build a house) as it does to (make a shield).	1 2 3 4 5 6 7	Is the comparison more difficult if the two activities are not going on at the same time? Yes/No
T6	To do activity A and then immediately do activity B, takes the same time all together as doing activity C.	1 2 3 4 5 6 7	If T6 is rated difficult, why is it difficult?
T7	It took a longer time to walk from A to B today than it did yesterday.	1 2 3 4 5 6 7	What would the literal translation be?
T8	Of three activities, A, B and C, activity C will take the longest time. (This could be discussed with an informant in relation to sports days, film nights, teacher's lesson preparation, etc.)	1 2 3 4 5 6 7	Are there any traditional activities for which this sort of statement would seem to the people to be relevant?
T9	ANY OTHER COMMENTS REGARDING THE CONCEPT, AND THE TEACHING OF TIME.		

Topic 5: SPEED

For Further Comment

S1	Does the language have an abstract term equivalent to the English word 'speed' as in the sentence "At what speed did they travel?"?	Yes/No	If yes, is the term (a) introduced? (b) traditional?
S4	The car was going at 60 miles an hour. N.B. USE MILES OR KILOMETRES, WHICHEVER IS THE MORE FAMILIAR TO THE PEOPLE.	1 2 3 4 5 6 7	
S5	A runs at the same speed as B.	1 2 3 4 5 6 7	
S7	A runs faster than B.	1 2 3 4 5 6 7	
S8	Runners A, B and C are all fast, but C is thefastest of all.	1 2 3 4 5 6 7	
SM1	The dog can run twice as fast as the boy.	1 2 3 4 5 6 7	
S9	ANY OTHER COMMENTS REGARDING THE CONCEPT, AND THE TEACHING OF SPEED.		

Topic 6: WEIGHT

			For Further Comment
W1	Does the language have an abstract term equivalent to the English word 'weight' as in the sentence "What weight is it?"?	Yes/No	If yes, is the term (a) introduced? (b) traditional?
W1.1	Are there terms equivalent to (a) heavy (in weight) (b) light (in weight)	 Yes/No Yes/No	You could mention other areas of meaning covered by the same words, e.g. in Warlpiri, the word 'pirrjirdi' is the name of a small damper made of seeds; the same word is used for 'heavy' and 'hard' (i.e. hard surface).
W2	Are there any local units for measuring weight which are in general use?	Yes/No	If yes, then state briefly what they are and under what circumstances they are used.
W3	The object weighs (some number of local units).	1 2 3 4 5 6 7	
W4	The object weighs *(5 kilograms). * OR ANY OTHER WEIGHT INVOLVING A STANDARD UNIT, e.g. 8 ozs.	1 2 3 4 5 6 7	How relevant would it seem to the people to be able to measure the weight of objects?

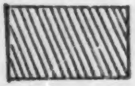
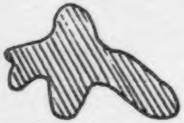
WEIGHT (Page 2)

			For Further Comment
W5	The two (stones; children; bags of bush tucker) are the same weight.	1 2 3 4 5 6 7	
W5.1	The weight of the (child) is equal to the weight of the (kangaroo).	1 2 3 4 5 6 7	If **W5.1** is rated as difficult, why is it difficult?
W6	A and B together are as heavy as C.	1 2 3 4 5 6 7	
W7	A is heavier than B.	1 2 3 4 5 6 7	
W8	A, B and C are all heavy, but C is the heaviest of all.	1 2 3 4 5 6 7	
W9	ANY OTHER COMMENTS REGARDING THE CONCEPT, AND THE TEACHING OF WEIGHT.		

Topic 7: AREA

			For Further Comment
A1	Does the language have an abstract term equivalent to the English word '*area*' as in the question "What is the area of the land you want?"?	Yes/No	If yes, is the term (a) introduced? (b) traditional?
A2	Is there any local method of measuring area?	Yes/No	Has the rising importance of the land rights question made any difference to the people's understanding of the measurement of area?
A3	The area of the (camp; garden; sports ground) is (local units).	1 2 3 4 5 6 7	
A5	The areas of these two (camps; gardens) are the same.	1 2 3 4 5 6 7	In what situations, if any, do you think the people would find it relevant to discuss whether or not two areas are equal?
A6	The area of A and the area of B together is equal to the area of C.	1 2 3 4 5 6 7	
A7	The area of this (garden; camp; football field) is bigger than the area of that one.	1 2 3 4 5 6 7	

AREA (Page 2)

			For Further Comment
AM1	  With reference to the above diagrams, how easy would it be to say that the areas of the figures are the same, although the shapes are different?	1 2 3 4 5 6 7	In what situations, if any, would it be relevant for the people to know that two differently-shaped surfaces could be equal in area?

A9 ANY OTHER COMMENTS REGARDING THE CONCEPT, AND THE TEACHING OF AREA.

Topic 8: VOLUME

			For Further Comment
V1	Does the language have an abstract term equivalent to the English word '*volume*'?	Yes/No	If yes, is the term (a) introduced? (b) traditional?
V1.1	Are there ways of expressing the volume of (a) a block of wood? (b) an amount of water? (c) a rock? (d) the amount of space in a house or other hollow object?	 Yes/No Yes/No Yes/No Yes/No	In English, the word '*capacity*' is often used when volumes of fluids are considered. Are different words used to describe the amount of space occupied by some solid, and the amount of fluid which a container can hold?
V3	The volume of this stone is equal to (some number of local units for measuring volume).	1 2 3 4 5 6 7	
V3.1	The volume of the water is equal to (some number of local units for measuring the volume of water).	1 2 3 4 5 6 7	
V4	This (petrol can; jug; soft drink can) holds *(5 gallons; 2 litres). * OR ANY OTHER STANDARD UNIT FOR MEASURING VOLUME.	1 2 3 4 5 6 7	Outside of school and work, in what situations would the people need to measure volume?

VOLUME (Page 2)

			For Further Comment
V5	This bucket and this tin both hold the same amount of water.	1 2 3 4 5 6 7	
V7	This tin holds less water than this bucket.	1 2 3 4 5 6 7	
VM1	Are there different terms to distinguish between (a) 'some' and 'full' as in "There is some water in the bucket" and "The bucket is full". (b) 'half full' and 'nearly empty' as in "The bottle is half full" and "The bottle is nearly empty".	Yes/No Yes/No	

V9 ANY OTHER COMMENTS REGARDING THE CONCEPT, AND THE TEACHING OF VOLUME.

Topic 9: MONEY

			For Further Comment
M1	Is there a general term for money?	Yes/No	If so, what is it? (For example, some people refer to money as stones or pebbles.)
M1.1	Are there different terms to distinguish between (a) 1 cent and 2 cent coins? (b) 5c, 10c, and 20c coins? (c) 20c and 50c coins? (d) the various notes; $1, $2, $5, etc.?	Yes/No Yes/No Yes/No Yes/No	What terms do the people use when talking about the various coins and notes? With which coin or note would the primary school child be most familiar?
M1.2	Do the various terms for money clearly express the relative value of the coins and notes?	Yes/No	
M4	The cost of the article is 20 cents.	1 2 3 4 5 6 7	
M6	The cost of A plus the cost of B is equal to the cost of C.	1 2 3 4 5 6 7	
M6.1	Five 20 cent coins are equal in value to a $1 note.	1 2 3 4 5 6 7	

MONEY (Page 2)

			For Further Comment
M7	A is cheaper than B.	1 2 3 4 5 6 7	
MM1	A gets $200 pay per fortnight.	1 2 3 4 5 6 7	Are the weeks divided into 'pay week' and 'off-pay week'?
MM2	A gets more pay than B.	1 2 3 4 5 6 7	
MM3	You will be paid $5 per hour.	1 2 3 4 5 6 7	How much difficulty do the people have in understanding the close relationship between pay received and hours worked?
M9	ANY OTHER COMMENTS ABOUT THE USE OF MONEY IN THE COMMUNITY AND TEACHING ABOUT MONEY IN THE SCHOOL.		

APPENDIX D

LANGUAGES COVERED IN SURVEY

APPENDIX D

LANGUAGES COVERED IN SURVEY

The following information is presented as it was given by respondents to questionnaires in 1977. Some of the details about the use of the language as a medium of instruction will be different now.

TIWIAN FAMILY (Prefixing)

Tiwi

1400 speakers

Schools: Bathurst Island, St. Therese's School and Xavier Boys School. At Garden Point and Snake Bay they speak a mixture of Tiwi and English.

Used as a medium of instruction.

Used by Tiwi teachers in all grades, and in the bilingual program in the lower grades. Most of the subjects in the bilingual program are taught in Tiwi, and in the higher grades Tiwi reading and writing is taught.

IWAIDJAN FAMILY (Prefixing)

IWAIDJIC GROUP

Wargbi Sub-group

Iwaidja

150 speakers

School: Croker Island

Not used as a medium of instruction. (The school has 60+ children speaking six different languages.)

Maung Sub-group

Maung

200 speakers

School: Goulburn Island Primary School.

Used as a medium of instruction.

For the first two years of schooling all reading and writing and most mathematics is in Maung. In the following years English is gradually increased. Oral English is taught from the beginning.

GUNWINGGUAN FAMILY (Prefixing)

RAINBARNGIC GROUP

Rembarrnga (Rainbarngo)

200 speakers

Schools: Possibly Malnjangarnak outstation school (an outstation school run from Milingimbi). At one or two other schools the language may be understood but not spoken by children.

At Malnjangarnak, with only Aboriginal teachers, the language is used regularly as the medium of instruction.

NUNGGUBUYAN FAMILY (Prefixing)

Nunggubuyu

400 - 600 speakers

School: Numbulwar

Used as a medium of instruction.

A bilingual education program is being introduced. The Pilot Group is in Infants 2 in 1977; all classes below this are taught in Nunggubuyu. Nunggubuyu traditional stories are told to primary classes as requested, 2-4 classes per week. Nunggubuyu is used as the language of instruction (sometimes) in subjects like Scripture and Health Education.

ANDILYAUGWAN FAMILY (Prefixing)

Anindilyakwa (Andilyaugwa)

1100 speakers

Schools: Umbakumba and Angurugu, Groote Eylandt, Northern Territory.

Used as a medium of instruction.

At Umbakumba there is a Type A bilingual program in the preschool and Infants I. They will probably be continuing vernacular mathematics instruction in Infants II. Angurugu School is classified as a Type B bilingual program. The preschool is bilingual. In infants and post primary classes the Aboriginal teaching assistants use Anindilyakwa.

MURINBATAN (GARAMAN) (Prefixing)

Murinbata (Garama)

200+ speakers

School: Port Keats

Used as a medium of instruction.

Used by the Aboriginal teachers in their daily instruction, and during 1977 in the bilingual program.

PAMA NYUNGAN FAMILY (Suffixing)

SOUTHWEST (OR NYUNGIC) GROUP

Wati Sub-group

Pitjantjatjara

3000+ speakers

Schools: Areyonga in the Northern Territory; Ernabella and others in the far north of South Australia.

Used as a medium of instruction.

Used by all teaching assistants at Areyonga as the main instructional medium in the lower two-thirds of the school.

Ngaanyatjarra

800 speakers

Schools: Warburton Ranges, Jameson outstation, Blackstone outstation and Giles outstation.

Used as a medium of instruction.

Used in the bilingual program at Warburton Ranges in Grades 1-3, with Aboriginal language literacy continuing in Grade 4.

Marngu Sub-group

Nyangumarta (Nyangumarda)

400 speakers

Schools: Strelley, Yandeyarra, and La Grange.

Used as a medium of instruction.

Parents work in conjunction with the teacher in the teaching areas (shade and wind shelters in each of the three camps) and use their own language to clarify and reinforce.

Ngarga Sub-group

Warlpiri (Wailbri, Walbiri)

2500 speakers

Schools: Yuendumu, Hooker Creek, Willowra, Warrabri.

Used as a medium of instruction.

At Yuendumu it is used from preschool to Grade 3 inclusive for oral and written instruction. From 4th grade to post primary grades only used in oral instruction. Used in written and oral instruction in all grades at Willowra. Some Warlpiri instruction is done at Hooker Creek, but there is not a full bilingual program.

Ngumbin Sub-group

Gurindji

With dialects, 400-500 speakers

Schools: Wave Hill Station School, and Kalkaringi (Wave Hill Settlement) School.

Not used as a medium of instruction (no details given).

Walmatjari

1300 speakers

Schools: Cherrabun, Gogo, Christmas Creek (stations), Camballin, Fitzroy Crossing. Many of the children understand the language well, but speak a pidgin or English.

Not used as a medium of instruction.

May be being used in some schools informally, but its use is not official policy.

ARANDIC GROUP

Urtwa Sub-group

Aranda (Western Aranda)

1000 - 2000 speakers

School: Hermannsburg

Used as a medium of instruction (details not given).

PAMA-MARIC GROUP

Middle Pama Sub-group

Wik Munkan

800 - 1000 speakers

Schools: Aurukun. Also at Edward River about 30% or more of the children speak Munkan dialects closely related to Wik Munkan. Also some at Coen.

Used as a medium of instruction.

Used in the bilingual school program at Aurukun for reading and oral instruction for the first three years or so, then as a subject in most higher grades. (This is still being established.)

Western Pama Sub-group

Kuuk Thaayorre (Koko Thaayorr)

250 - 300 speakers

Schools: Pormpuraaw State Primary, Edward River, North Queensland.

Used as a medium of instruction. Bilingual program in grades 1 - 3, and a half-hour of culture four days weekly in Grades 4 - 7.

YALANJIC GROUP

Gugu-Yalanji (Koko Jelandji)

500 speakers

Schools: Bloomfield River, Daintree, Mossman.

Used as a medium of instruction (no details given).

MURNGIC GROUP

Yulngu Sub-group

Gumatj (Gumadji)

200 speakers

School: Yirrkala

Used as a medium of instruction.

Gumatj is used in the primers for the bilingual program.

Djambarrpuyngu (Djambarbuyngu)

Number of speakers not known.

Schools: Milingimbi, Elcho Island, Lake Evella.

Used as a medium of instruction.

Used in the bilingual program by all teaching assistants and Aboriginal teachers.

CREOLE

English Creole (South Pacific)

Roper River Creole*

2000 speakers

Schools: Ngukurr Roper River, Bamyili, Roper Valley, Hodgson Downs, Newcastle Waters, Elliot, Beswick, Hodgson River, Mountain Valley, Bulman.

Used as a medium of instruction.

At Bamyili there is a full bilingual program in infants and preschool. At Ngukurr there is an informal bilingual program. In the other schools mentioned it is not used in school.

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* Being a creole, this language is not listed in Wurm's (1972) classifications. Classification here is as given by the respondent.

APPENDIX E

IDENTIFICATION OF RESPONDENTS AND ABBREVIATIONS OF LANGUAGE NAMES

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IDENTIFICATION OF RESPONDENTS AND ABBREVIATIONS OF LANGUAGE NAMES

Respondent and Helper(s)*	Location	Language	Abbreviation
Eirlys Richards and Joyce Hudson	Fitzroy Crossing, W.A.	Walmatjari	(Walm)
Amee Glass	Warburton Ranges	Ngaanyatjarra	(Ngaa)
Mrs G. A. Bucknall	Strelley (Port Hedland)	Nyangumarta	(Nya)
Chris Kilham and Mrs Topsy Walmby	Aurukun (North Queensland)	Wik-Munkan	(Wik)
Joyce Ross and Mutilnga	Yirrkala, N.T.	Gumatj	(Gu)
C. S. Street	Port Keats, N.T.	Murinbata	(Mur)
Hank and Ruth Hershberger	Ayton via Cooktown. Qld.	Gugu-Yalanji	(Gg-Y)
Judith Stokes with Nabilia Lalara and Julie Waddy	Angurugu, N.T.	Anindilyakwa	(Anin)
Velma J. Leeding with Aboriginal language helper	Umbakumba, N.T.	Anindilyakwa	(ANIN)
Rev. Dr. Allen H. Hall	St. Lucia, Brisbane	Kuuk Thaayorre	(K-Th)
Mary Laughren	Yuendumu, N.T.	Warlpiri	(Warl)
Marie Godfrey	Nguiu, Bathurst Island, N.T.	Tiwi	(Tiwi)
Noreen Pym, in co-operation with Dietrich Moeckel, Headmaster	Croker Island, N.T.	Iwaidja	(Iw)

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* Identification is as shown on each questionnaire, and is not always a true indication of how many people assisted with the completion of the questionnaire.

Heather E. Hewett	Goulburn Island, N.T.	Maung	(Ma)
Robert Capp	Areyonga, N.T.	Pitjantjatjara	(Pitj)
Kathie Warren	Numbulwar, N.T.	Nunggubuyu	(Nung)
N. & H. McNair	Wave Hill Settlement, N.T.	Gurindji	(Gur)
John Rudder	Galiwinku (Elcho Island) N.T.	Djambarrpuyngu and Gupapuyngu	(Dja)
Rev. John C. Pfitzner	Hermannsburg, N.T.	Aranda	(Ar)
Warren Hastings with Winston Thompson, Robyn Rogers and Jimmy Ashley	Ngukurr School, Roper River, N.T.	Creole, Roper River	(RoCr)
L. Kuipers	Hooker Creek, N.T.	Warlpiri	(W-HC)
G. R. McKay	Maningrida	Rembarrnga (with comments on Djeebbana (Gunibidji)	(Rem)

APPENDIX F

ABORIGINAL QUESTIONNAIRE

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ABORIGINAL QUESTIONNAIRE

In August 1977 the writer was invited to address the Mathematical Association of Victoria on the use and relevance of mathematics in tribal Aboriginal communities. Some results of the study described in this report were presented to the meeting, and the point was made that the questionnaire that had been used was based on an ethnocentric point of view, and only showed how Aborigines respond to Western ideas of mathematics, without revealing what mathematical ideas are meaningful in Aboriginal society.

To illustrate the point, the writer suggested that the audience should try to imagine how they would feel, and how intelligent they would appear, if some tribal Aborigines in the "University of the Desert" wrote a similar questionnaire from *their* point of view, and sent it to teachers and mathematicians in Melbourne and Sydney.

For a start, it was thought that the choice of topics would be completely different in the Aboriginal person's questionnaire. He may not even include the study of measurement at all. A look at some of the major anthropological works dealing with Australian Aborigines indicates that relationships between people are of paramount importance in Aboriginal society*, and the work by Lewis cited in Chapter 1 clearly illustrates the importance of spatial relationships for survival in the desert. It was therefore thought that an Aboriginal questionnaire on mathematical ability would give priority to kinship relations and spatial orientation.

The following questions were presented to the audience of mathematicians and maths teachers, and answers and comments were called for. Like the Aboriginal language helpers mentioned in Chapter 6 they could only give negative answers such as, "No, we do not have a term like that", or "We *could* say that, but we wouldn't want to", or simply the comment "That's not relevant to our way of life".

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*See, for example, Chapters 4, 5, and 6 of Elkin's (1974) *The Australian Aborigines,* or Chapters 7-12 of Meggitt's (1962) *Desert People*. The kinship classifications and terminology described in these books are extremely complicated, and very difficult for any non-Aboriginal person to master, yet they are a natural part of life for the Aboriginal child.

Topic 1: KINSHIP

K1 Are there 8 subsections in the tribe? Yes/No

If the answer is No, then how many subsections are there?

K2 Are there separate terms to distinguish between -

(a) mother's brother
(b) father's brother Yes/No

If yes, are these terms familiar to the young child entering school?

K3 Is there a concise way of expressing the relationship between two persons, one of which is in the subsection of Ego's mother, and the other in that of his mother's father? Yes/No

How would this relationship be expressed in your language?

Topic 2: SPATIAL ORIENTATION

S1 Are there separate terms for -

(a) North Yes/No
(b) South Yes/No
(c) East Yes/No
(d) West Yes/No

Are these terms commonly used in the classroom, for example when teaching the shapes of letters on the blackboard?

In what situations is it relevant for the children to know their own position in relation to the cardinal points of the compass?

S2 Do the verbs in your language indicate the direction of the action in relation to the speaker, as in the following Warlpiri examples?

parnkami	'running'	
parnkamirni	'running towards the speaker'	Yes/No
parnkamirra	'running away from the speaker'	Yes/No
parnkamimpa	running across, with side towards the speaker'	Yes/No

If not, how are these spatial relationships expressed in your language?

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